

MOTIVATION AND MEANS: How and Why IPD and Lean Lead to Success

Research Report
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University of Minnesota in collaboration with University of Washington, University of British Columbia, Scan Consulting
Sponsored by Integrated Project Delivery Alliance (IPDA) & Lean Construction Institute (LCI)



Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Executive Summary

Executive Summary (1 of 4)

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AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE

MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

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The report *Motivation and Means: How and Why IPD and Lean Lead to Success* presents a study of ten recent successful building projects in the United States and Canada using an integrated form of agreement. The yearlong, in-depth study focused on the questions of how and why are integrated project delivery (IPD) and Lean effective. Our conclusion is that IPD sets the terms and provides the motivation for collaboration; Lean provides the means for teams to optimize their performance and achieve project goals.

The overall findings are consistent with the larger body of research showing that teams using IPD and Lean are more reliable in terms of the schedule and cost and in meeting the owner's goals. This research adds to the evidence of the effectiveness of IPD and Lean, and by documenting positive examples in a systematic and rigorous manner, begins to identify the motivations and mechanisms for collaboration that are key to project success.

FINDINGS AND OBSERVATIONS

Our major finding was a striking uniformity of success for all the teams in this study, regardless of project type, scope, geographic location, or previous experience with IPD and Lean. The second finding was that the powerful complementary strength of IPD and Lean supports success. While there was a great deal of variation in how success was achieved, these teams reinforced current research conclusions that IPD and Lean teams are reliably able to meet schedule and cost and in meeting the owner's goals for quality. It should be noted that because the subjects of the study were volunteers who gave researchers access to their documents and their time, they were more likely to be teams that sought to highlight their positive experiences and may

not be representative of all IPD projects. At the same time, the teams were very candid about the significant challenges they faced, mistakes made, and lessons learned. Based on these stories and the overall successes, these teams demonstrated a remarkably consistent attitude of team first or project first that gave them the enhanced ability to anticipate complexity and a great resiliency to recover from unexpected setbacks. With our limited sample size of uniformly successful projects, we cannot confirm a causal path that IPD and/or Lean led to resilience, but we have many positive stories of team members attributing their ability to overcome challenges to mechanisms within IPD or ways of thinking elicited by Lean.

For many of the owners and teams, the choice to use Lean tools and processes was seen as an integral decision in choosing to pursue IPD. Most owners, regardless of their previous project delivery experience, believed that IPD facilitated (or in some cases, contractually obligated) the use of Lean practices. In our interviews, many owners and teams conflated the two terms and used them interchangeably. Since Lean and IPD are often considered together, it may not be useful to draw a black-and-white distinction between the two. However, for the purposes of this study, we define IPD as the contractual project delivery method used by these project teams that created shared risk/reward structures, fiscal transparency, and release of liability. We define Lean tools and processes as the specific tools and processes outlined by Lean Construction Institute as well as the variations developed by the teams that share the intent and spirit of those tools. The way IPD and Lean worked for these teams is that IPD provided a contractual environment and motivation for collaboration through sharing of risk and reward, early involvement and equality of stakeholders, project-first thinking, limitation of liability, and some of the

mechanisms for trust (development of the contract, open-book transparent finances, shared understanding of each other's goals, values, and business objectives). Lean provided the means by which to focus the team's energy to collaborate effectively for cost (particularly target value design), schedule (Last Planner System, which includes pull planning, reliable promising, and plan percent complete), and other goals that could be developed and aligned using Lean tools (such as A3, Plus/Delta, or plan-do-check-act). Lean tools and processes provided the most consistent metrics for team productivity and progress toward project goals, but we also saw examples of teams developing customized worksheets, dashboards, or matrices that provided additional and tailored mechanisms for measurement.

TEAMS MATTER: IDENTIFYING, BUILDING, AND SUPPORTING A SUCCESSFUL TEAM

There is a common industry perception that collaborative behavior occurs spontaneously within a group of high-performing team members and that it cannot be dictated by contracts or mandated by decision-making structures. Our findings offer a different reading of how collaboration occurs: we believe it can be *fostered* by IPD contracts and Lean processes and tools. One architect in our study said IPD and Lean are "always a carrot, never a stick." As "carrots," they enhance team members' willingness and ability to collaborate. We found examples of team formation that place emphasis on motivating, aligning, and mentoring the team, as well as using active and intentional on-boarding and off-boarding processes. Together, these practices *cultivated* high-performing team behaviors because members were supported, encouraged, and rewarded for collaborative approaches to project challenges.

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In our previous research (see literature review for past case studies and surveys), we closely examined team culture and how it can be measured as an outcome as well as a contributor to overall project success. Based on a study of projects with a range of outcomes, we were able to establish a causal relationship between positive building outcomes, positive team outcomes, and the key ingredients that contributed to both, namely, mutual trust and respect, accountability, and effective communication. For this study, we chose to build upon that work and focused more specifically on how the team interacted with the owner and translated the owner's goals into action. All the projects in this study had very positive team cultures, ranking as high as any of the top-performing projects we have studied—this makes it harder to establish causal relationships since the results are so uniformly positive. However, the findings in this study align with prior research, which validates these findings. This study provides the industry with a guide to why these teams were successful.

The owners in this study considered or committed to IPD before starting to form the collaborative teams. Through interviews, surveys, and document review, we observed that all of the teams functioned as high-performing collaborative partners who were able to meet project challenges and successfully deliver projects that met the owners' goals. There were some common strategies and processes. All projects had effective processes to:

- identify potential team members;
- select team members and award the contract;
- build, coach, support, and strengthen the team throughout the project duration.

With these teams, the process of identifying team members and awarding the contract typically included some discussion of who would be included in the agreement and who would be included in the risk/reward pool.

We studied how the teams demonstrated their mutual trust and respect (sometimes called psychological safety) and how champions came from all levels and areas of expertise. Lastly, we traced how the teams used mechanisms for team building, such as learning and self-assessment, to cultivate the team-first or project-first spirit so evident in interactions across the projects. The high camaraderie and empathy within the teams and the described hard-won understanding of each other's business practices allowed partners to candidly call out problems and work together to find solutions. The teams were resilient and worked together without blame (or learned to do so) and were able to accommodate new ways of working, even when they were not comfortable.

The most significant finding in the area of team culture was that these teams were effective in making sense of the owners' goals and translating this understanding into action, even in cases when the goals were not completely clear or there were changes that occurred over time. In these case studies, 100% of the owners believed projects met or exceeded expectations for budget and schedule, even if not all the projects met the initially identified targets.

There are several future research opportunities to better understand IPD and Lean project teams: First, there is a need to develop rules of thumb on the number and diversity of the incentive-pool members, which could be related to the overall size of team, project scope, complexity of the project, level of experience with collaborative delivery, or all of these. Second, the industry needs to better define and validate on-

boarding techniques and team-building efforts, particularly to see how self-assessment tools that evaluate core strengths, personalities, and communication styles work for teams in the building industry. Third, there is a need for further research into the motivational effects of financial stake, particularly for architects and engineers who are different from the constructor team members in the timing of their input to optimize their affect on project costs.

MEANS AND METHODS OF COLLABORATING: WHAT IS ESSENTIAL AND WHAT IS OPTIONAL

While we documented several common tools, metrics, methods, and approaches among several teams, for every team that found a particular approach essential, another team found it too cumbersome. This set of cases suggests that building information modeling (BIM), co-location, and pull planning fall into the "could be essential if done well" category; while validation and metrics are "essential and need to be done well." To do IPD well requires a strong team-oriented project culture with a sustained investment in team building throughout the project.

IPD also requires an investment in early planning as well as team building. We consistently heard from teams that managing the time required for early planning, coordination, and fiscal reporting is challenging. At the same time, teams noted time saved in the later parts of the project because of the early planning. Additionally, teams described that their time and energy was more positively directed to advance project goals since time was not wasted on resolving conflicts and documenting changes to avoid dispute. Based on these cases, more research is needed to quantify the shifts in the amount of time, level of personnel, and

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intensity of engagement on IPD projects as these are not yet well understood. These teams often started from scratch and developed planning and project-administration time requirements over the course of the project.

In these projects, there was a relationship between teams with a high degree of Lean practices and the most positive collaboration outcomes. The project teams with the most positive perception of their team's culture and effectiveness also tended to have invested the most in planning and communication, particularly in Lean processes and tools. While we saw a correlation, more research would be needed to fully understand this relationship. For example, correlation may be due to the increased awareness and intentional goal setting around team effectiveness, or it may be that the activities around Lean planning provided a base for stronger team culture.

MARKERS AND METRICS

Traditional markers of project success are budget and schedule. However, we found that these measures are highly dependent on the ability of the team and owner to accurately judge market costs and to establish feasible targets at the beginning of the project. Furthermore, outside market variables impact these metrics and do not necessarily reflect the quality of the team and their attention to the project goals.

From the onset of this research effort, we hoped to find more consistent development and use of alternatives to cost and schedule metrics. While there were excellent examples of effective metrics, the industry is far from establishing commonly accepted industry standards that could drive improvement. Project teams, even with high-performance

building goals, often defaulted to cost and schedule metrics to measure the project's success. We were able to track profit and payout for the projects in this study and gather feedback from individual companies on their performance with IPD in general and on these specific projects.

We observed that the team-culture behaviors that the teams engaged in most consistently were marked by a number of traits, including clear communication between all members of the project team, fluid trading of scope during construction, team experiences reported as fun, reported excitement about the project, and generally less conflict. When compared with their experiences in traditional delivery, the owner and team of these projects spent more energy on advancing the project and less on blame and defense. These are areas that show promise in the development of metrics for team culture and engagement that would allow project managers to better assess the health of the team as the project is underway.

CONCLUSION

Research into understanding IPD and Lean is complex. By documenting positive examples in a systematic and rigorous manner, this research adds to the evidence of effectiveness for IPD and Lean and also begins to identify the motivations and mechanisms for collaboration that are keys to their success.

NAVIGATING THIS REPORT

The presentation of each case follows the framework described in the Methodology section. An interactive matrix format allows review of topics found within one project or the review of one topic across multiple projects.

Case studies can be navigated with the left side menu; comparative analysis allows viewers to see summaries of the findings related to topic tabs arrayed on the top navigation bar.

The top navigation bar contains tabs within six primary categories: Context, Legal/Commercial, Leadership Management, Processes & Lean, Alignment & Goals, and Building Outcomes.

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CASE STUDY COMPARISON TRUTH TABLE

We supplemented the descriptive analysis and in-depth cross-case analysis with a truth table that shows how each of the cases leveraged Lean Construction tools and processes. Using interview data and document review, we determined the shared practices across the projects and the degree to which the teams were able to effectively implement the tools and processes. This truth table analysis allows us to display the variables in a way that lets a reader quickly understand the complexity of the cases. By creating a graphic visualization of the data on building projects we show the variety amongst the cases as they implemented Lean Construction tools and processes.

TRUTH TABLE - LEAN CONSTRUCTION TOOLS & PROCESSES

The table shows how each team leveraged tools and processes. **Validation:** a document produced by team, allowing the team to collectively say with confidence, "We can build this building with this cost and time," and showing a commitment to the target cost. Documentation of building can be in the form of a narrative, drawing, etc. and provides the team and owner with critical information to judge if the project should proceed. **Co-Location:** defined as a work space shared by all stakeholders. Actual implementation of co-location ranged from a permanent dedicated space used by all of the members of the risk/reward pool to an ad-hoc space or space shared only by the contractor and trade partners. **Team Formation:** includes the selection process for identifying team members and on-boarding. **Team Development:** describes team building through such means as facilitated training, team assessments, individual assessments, and continuous reflection. **Goals:** include establishment of goals and how they were documented and progress tracked with metrics. **Workplace and Meeting:** includes how both physical and virtual workspace were utilized, including daily huddles and agendas. **Cost and Decision:** defined as the way the team set up decision-making with Choose by Advantages, set based design, and how they managed costs with continuous conception estimating, target value design. **Project Management:** includes Last Planner System and its sub elements, such as reliable promising. **BIM:** includes the effectiveness and degree of collaboration around BIM.

	Validation	Co-Location	Lean Tools and Processes						BIM
			Lean Team Formation		Goals	Workplace and Meeting	Cost and Decision	Project Management	
			Team Formation	Team Development					
Akron	●	●	●	●	●	●	●	●	●
Autodesk		●	○	○	○	●	●	○	●
Mosaic	●	●	●	●	●	●	●	●	●
Quail Run		○	●	●	●	●	●	●	●
Rocky Mountain	●	●	●	●	●	●	●	●	●
St. Anthony	●	●	●	●	●	●	●	●	○
Sutter Los Gatos		●	●	●	●	●	●	●	●
Sutter Sunnyvale	●	○	●	○	●	●	●	●	●
T. Rowe Price		●	●	●	●	●	●	●	○
Wekiva Springs	●	●	●	●	●	●	●	●	●

- Done well, used often, helpful to the team
- Done, but only somewhat helpful or mixed comments about its effectiveness
- Did it, but it was not seen as particularly effective by most of the team
- Did not have it

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Research Methodology

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The projects in this study were selected based on the following criteria:

1. Provided incentives (such as reward pool) involving more than three stakeholder groups.
2. Used some form of integrated agreements, such as multiparty (three signatories), poly-party (four or more), charters, riders, etc.
3. Used some form of Lean design and construction practices, tools, and methodologies.
4. Was completed by Dec 31, 2015.

Secondary criteria were used to ensure geographic distribution, variety of project types, owner types, and experience levels. Using an Integrated Form of Agreement (IFOA) was not originally a criterion, but all projects selected happened to use some form of integrated agreement.

Given the complexity of project delivery, there are a large number of potential variables that affect not only team culture and performance but also the reliability of project outcomes. For these integrated project delivery (IPD) case studies, information was collected through 1) interviews with the owner representatives, architects, engineers, and builders, 2) project documents, and 3) a project team survey. In general, we sought to collect documents, interview stakeholders, and then conduct a team survey. However, due to the team's availability, we did not follow this sequence strictly and often followed up the interviews with further document requests. Through the analysis of these three types of case-study data, we were able to internally validate the project findings. Each data source was, for the most part, complemented the other sources. However, the slight differences in perspectives

provided the research team with a nuanced and layered understanding of the projects.

Based on our past research on collaborative delivery and informed by our research goals for this project, we created six categories common to all projects in this report: **Context, Legal/Commercial, Leadership/Management, Processes/Lean, Alignment/Goals, and Building Outcomes**. **Context** includes the specific risks and parameters that the project team worked with, such as budget and schedule. Our research team created diagrams describing the teams' interface with the owner and the key decision-makers within the owner group. **Legal/Commercial** includes the contract type and the range of processes used to select the team, develop the contract, and identify the members of the risk/reward pool. **Leadership/Management** describes the internal champions of IPD and Lean and the structure of decision-making developed by the team. This category also includes the processes used for bringing team members on board and for their removal, and the ways that the teams defined, understood, and eventually implemented measures to achieve the project goals. The **Processes/Lean** category describes how facilitators supported the teams, the team's implementation of Lean tools, and the effectiveness of Lean practices. It also includes the ways that building information modeling (BIM) was used and how the teams used co-location. **Alignment/Goals** is the category that relates to team culture, such as their alignment around goals and the team's ability to collaborate. **Building Outcomes** provides information on profit and the payout of the risk/reward pool and describes how the teams achieved budget, schedule, and other project goals.

NARRATIVES AND INFOGRAPHICS

The narrative text and information graphics were produced by the research team based on analysis of the interviews, document review, and survey results. The project teams were given drafts narratives for fact checking and to verify that quotes were employed in the correct context. The research team reported data consistently for the infographics,; in some cases this information was directly from the project teams, in others the research team worked with the project teams to parse their data in ways that worked for the report. In some cases, teams were still finalizing their numbers; in others, information was confidential. The table on Lean tools and BIM reflects the research team's evaluation on the effectiveness and extent of use of those tools. Peer reviewers—unbiased industry or academic experts – were invited to review an interim and the penultimate version of the report.

CASE STUDY COMPARISON TRUTH TABLE

Using techniques from qualitative comparative-analysis methods, we developed a summative tool called a Truth Table. This allows the team to map out key aspects of each case in a comparative-table format. Each case is shown represented by a row, while each variable is shown as a column. In the body of the table, we indicated if the variables were strongly represented in a case or partially represented in a case. If the variable was not present in a case, we left the cell blank. This allows the reader to quickly assess the variables as they related to the cases. We found that most projects have some types of Lean tools, and other tools were used less often. The results of the Truth Table analysis are shown in the Executive Summary.

Research Methodology

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DOCUMENTS

In order to understand the specific interactions within the team, we asked for a variety of documents that defined the processes and policies of the project. We reviewed documents pertaining to the general management of the project, including contracts, project directories, and artifacts that showed how decision-making, and meetings were organized. To understand the workplace environment, we looked at office floor plans for co-located teams, photographs of BIM rooms, and photographs or screenshots of interactive tools. For tools and processes, we sought documents that contained protocols and planning information, such as the BIM-execution plan, A3 protocols, or Last Planner System framework. We requested that the teams share samples of Lean tools used, request for information (RFI) logs, or other project metrics they used to measure progress, communicate, and coordinate work across the disciplines. The teams were extraordinarily open and transparent in sharing their documents to help the research team gain a full understanding of the projects.

INTERVIEWS

We conducted interviews with key project participants in stakeholder groups, based on their role on the project: owners and owner representatives in one group, architects in another group, general contractors in a third. At times, we had a chance to interview design consultants and subcontractors in separate groups as well.

For these interviews, we developed two closely related but tailored and structured interview questionnaires. One questionnaire was created to address the owner point of view (given to the owners, and owner’s representatives) and a

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Documents

All teams provided documentation in each of these categories, though the specific artifacts varied:

- Commercial and legal**
 - Request for proposal (RFP)
 - Request for qualifications (RFQ) and criteria for selection
 - IPD agreement and contract exhibits, such as risk/reward distribution, milestone payouts
 - Budget and other financial documents
- Decision-making**
 - Protocols for decisions
 - Sample documents related to major decisions by the core team
 - Sample communication of decisions to the larger team
 - Documentation of goals
 - Protocols for meetings
 - Meeting schedules and agendas
 - Sample meeting minutes
- Lean, other tools and metrics**
 - Samples of A3s and, pull plans
 - Samples of customized tools, screen shots
 - Protocols on how tools were used, including dashboards
 - Metrics, including key- performance indicators and other metrics tracked
 - RFI logs
 - Risk registries
- BIM**
 - Execution plan
 - Sample snap shots of models
- Workspace environment**
 - Plans and photographs of shared workspaces
- Project personnel**
 - Project directories
 - Personnel lists
 - Organizational charts

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second one for project stakeholders such as architects, general contractors, consultants, and subcontractors.

Interview topic areas:

1. Profile/experience/demographics
2. Metrics
3. Commercial/legal terms
4. Team culture
5. Processes, tools, and workplace environment

In the first category, we captured the team member’s past experience with IPD and Lean and had discussions on the perceptions/reflections on the owner’s market sector, experience with construction, and general familiarity with IPD and Lean. For metrics, we asked the team how they measured success on the project. In commercial terms, we investigated the aspirations for using IPD, the development of the contract, and how the contracting terms and processes impacted team culture and performance. Under team culture, we asked the team members to describe team member selection and the joint decision-making processes. In the process and tools category, we focused on Lean processes and BIM tools as well as notable general workplace organizational strategies. In the analysis we further refined these topics, and this refinement is presented in the structure of this report, with the final categories shown in the heading above.

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NUMBER OF INTERVIEWS (PEOPLE INTERVIEWED)	ARCHITECTS	ENGINEERS, CONSULTANTS	BUILDERS	OWNER, OWNER CONSULTANTS	TOTAL
AKRON	2 (5)	2 (3)	2 (7)	1 (5)	7 (20)
*^ AUTODESK	1 (2)		2 (2)	3 (4)	6 (8)
SUTTER LOS GATOS	1 (2)	1 (1)	1 (1)	2 (2)	5 (6)
^ MOSAIC	1 (2)	2 (3)	5(8)	1 (1)	9 (14)
QUAIL RUN	1 (2)	1 (3)	(3)	1 (2)	3 (10)
*ROCKY MOUNTAIN	1 (3)	1 (2)	1 (3)	2 (3)	5 (11)
ST. ANTHONY	1 (1)		1 (1)	3 (4)	5 (6)
SUTTER SUNNYVALE	1 (2)	1 (1)	1 (1)	2 (2)	5 (6)
*^ T. ROWE PRICE	1 (2)	2 (3)	3(5)	2 (3)	8 (13)
WEKIVA SPRINGS	1 (1)	1 (1)	1 (1)	1 (1)	4 (4)
TOTAL	12 (23)	11 (17)	18(36)	4 (6)	60 (104)

* for this project, owner category includes owner and owner consultants

^ for this project, the builders category includes general contractors and trade partners

NUMBER OF INTERVIEWS OF PROJECT PARTICIPANTS BY ROLE

Key: number of interviews (number of participants)

For example, 2 (5) represents two interviews with a total of five interviewees.

Note: The categories of architect, engineers, and owner were fairly consistent and easy to define. The owner-consultant category included owner’s representatives as well as other consultants, such as furniture providers or other specialties. The builder category included general contractors and trade partners. Our research team defined trade partners as trade contractors, such as electricians, who were included in the risk/reward pool. There were a few companies that served dual roles, such as mechanical engineer and mechanical contractor. In those cases, we categorized the interviewee according to their primary role on the project.

Research Methodology

Context				Legal Commercial			Leadership & Management				Processes & Lean					Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Research Methodology (4 of 4)

SURVEY

To supplement the detailed interview data, we cast a broader net across the project participants with a survey. Following a series of project- and respondent-demographic questions, a project-profile section asked questions measuring successes across project team activities, owner engagement, and the managerial effects of the multisignatory agreement. A section on team culture examined the characteristics of collaboration, decision-making, and goal alignment that probed the details of project management structures and the impact of daily activities on project collaboration. The process and tools section looked at the level of Lean- and BIM-tool use in the project and asked respondents to compare use to previous experience. The metrics section asked respondents to identify the measurements used to manage project work flows and achievements and how those metrics impacted the work of the project team. These categories included professional skills, like communication, accountability, transparency, and trust, as well as outcomes, like effective decision-making, commitment and improvement, and goal alignment with the owner and across the team. Questions were also asked about significant project outcomes, like cost, schedule, energy performance, and sustainability, that offered motivation and challenge to the project team. The last section compared respondent’s experiences with IPD on past projects to how this project team performed in terms of budget, schedule, building quality, and overall value in the projects of this study and whether they would choose to use IPD in the future or recommend it to others.

- AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION
- AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE
- MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE
- QUAIL RUN BEHAVIORAL HEALTH HOSPITAL
- ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER
- ST. ANTHONY HOSPITAL
- SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)
- T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1
- WEKIVA SPRINGS CENTER EXPANSION

NUMBER OF SURVEY RESPONSES	ARCHITECTS	ENGINEERS, CONSULTANTS	^ BUILDERS	OWNER, OWNER CONSULTANTS	TOTAL
AKRON	3	1	13	2	19
AUTODESK	3	4	12	2	21
SUTTER LOS GATOS	1	1	2	1	5
MOSAIC	2	3	6	1	12
QUAIL RUN	2		5	3	10
*ROCKY MOUNTAIN	4	5	8	7	24
*ST. ANTHONY	8	6	6	2	22
SUTTER SUNNYVALE		3	3	1	7
*T. ROWE PRICE	2	4	4	3	13
WEKIVA SPRINGS	1	4	6	1	12
TOTAL	26	31	65	23	145

* for this project, owner category includes owner and owner consultants
 ^ for all projects, the builders category includes general contractors and trade partners

NUMBER OF COMPLETED SURVEYS BY PROJECT PARTICIPANTS BY ROLE

Questionnaire participants self-identified with the categories of architect, engineer/consultant, builders, subs, owners, owner consultants. In the project narratives, our research team used the term trade partner for those contractors who were included in the risk/reward pool and subcontractor for those trades who were contracted with the general contractor and not included in the risk/reward pool.

Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Literature Review (1 of 4)

- AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION
- AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE
- MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE
- QUAIL RUN BEHAVIORAL HEALTH HOSPITAL
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- ST. ANTHONY HOSPITAL
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- WEKIVA SPRINGS CENTER EXPANSION

It is becoming clearer that to deliver construction projects in today's rapidly changing and increasingly complex and competitive environment, project teams must rethink how they organize themselves and collaborate. Over the past three decades, efforts to remove various barriers found within project teams—whether technological, organizational, procedural, or cognitive—have resulted in better-performing projects due to improved flows of information, materials, and other resources throughout a project's life cycle. These efforts include new contractual mechanisms, such as integrated project delivery (IPD), the embracing of innovative production philosophies, such as Lean design and construction, and support by tools and technologies, such as building information modeling (BIM), that are aimed at minimizing waste while producing optimal outcomes for the client. There is growing consensus among industry stakeholders that these approaches indeed help produce better team and project outcomes.

While this growing consensus is leading many owners to look toward employing these innovative approaches to project delivery, the barriers to entry remain high. This is in part due to the complexity of the implementation process and the lack of generalized expertise in these areas. Previous investigations into the performance of construction-industry project teams in the context of innovative approaches to project delivery have identified the factors and conditions that are seen as key to supporting and enabling these teams to be as effective and efficient as possible. Several of these factors have been consistently highlighted in studies. For instance, the impact of shared risk and reward and early involvement of all parties have been investigated both in studies on IPD (Molenaar et al. 2015; AIA 2012; Kent and Becerik-Gerber 2010; Cohen 2010) and in studies on other project delivery

modes (Esmaili et al. 2013; Korkmaz et al. 2010; Chan et al. 2001). Similarly, implications of project stakeholder's level of experience (Molenaar et al. 2015; Esmaili et al. 2013; AIA 2012; Kent and Becerik-Gerber 2010; Korkmaz et al. 2010) and to a lesser extent owner experience (Molenaar et al. 2015; Korkmaz et al. 2010; Chan et al. 2001) with the approach have been correlated to project performance. Finally, the impact of team tools and processes, such as BIM and Lean, have been investigated in the context of innovative project delivery (Cheng 2015; Molenaar et al. 2015; Esmaili et al. 2013; AIA 2012; Cho and Ballard 2011; Kent and Becerik-Gerber 2010; Cohen 2010).

To measure the impact of these approaches, researchers have developed metrics and indicators for both team and building performance: team outcomes in the form of how well teams collaborate and building outcomes in the form of how well projects perform. The impact of team tools and processes, such as BIM and Lean, have been investigated in the context of innovative project delivery (Cheng 2015; Molenaar et al. 2015; Esmaili et al. 2013; AIA 2012; Cho and Ballard 2011; Kent and Becerik-Gerber 2010; Cohen 2010). With regards to building outcomes, the traditional indicators of cost, time, quality, and safety continue to be widespread (Cheng 2015; Molenaar et al. 2015; Asmar et al. 2013; Esmaili et al. 2013; AIA 2012; Cho and Ballard 2011; Kent and Becerik-Gerber 2010; Korkmaz et al. 2010; Chan et al. 2002; Chan et al. 2001; Konchar and Sanvido 1998). Fewer studies have looked into scope change (Asmar et al. 2013; Kent and Becerik-Gerber 2010), owner satisfaction (Cheng 2015; AIA 2012; Chan et al. 2002), and sustainability and environmental performance (Cheng 2015; Molenaar et al. 2015; Asmar et al. 2013; Korkmaz et al. 2010; Chan et al. 2002).

This earlier work sets a considerable foundation for understanding that these innovative project delivery approaches and strategies do indeed help project teams perform better. Indeed, the evidence overwhelmingly supports this. The question that remains, however, is not so much if these approaches are indeed better but rather how and why they are better. These are the questions that this research project sets out to answer.

In the following literature review, we present three social theories that address how and why team performance is better in collaborative delivery: forming communities, groups, or teams; goal setting and alignment; and creation and sustaining team culture. These themes emerged from the case-study synthesis and are echoed in the cases presented in this study. While not exhaustive, these themes and the literature referenced herein frame the case narratives and highlight the importance of team building in IPD and why Lean methods create reliable outcomes.

1. COMMUNITIES, GROUPS, AND TEAMS

It is well known that the construction industry relies on multidisciplinary teams to deliver its projects. Traditional approaches, based on transactional contracting methods, aim at establishing clear boundaries between the different stakeholders and their responsibilities. This hinders the creation of highly effective teams and true collaboration because these boundaries impede the flows of knowledge and information that are necessary for successful project delivery. IPD and Lean were developed in part to eliminate these barriers and to better support flows within multidisciplinary project teams. Indeed, IPD challenges the traditional notion of a team and redefines the meaning of teamwork throughout

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Literature Review (2 of 4)

- AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION
- AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE
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- QUAIL RUN BEHAVIORAL HEALTH HOSPITAL
- ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER
- ST. ANTHONY HOSPITAL
- SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)
- T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1
- WEKIVA SPRINGS CENTER EXPANSION

a project's life cycle. IPD reconfigures the distribution of labor and seeks flatter, more agile organizational structures. It also impacts the sequencing of team development and formation as well as the emergence of team-level constructs and behaviors, such as intra-team trust. Yet given the relative novelty of these approaches, going about choosing IPD and setting up and managing an IPD team are significant challenges.

Reliance on groups of individuals—communities that exist beyond the projects themselves and that are organized around specific knowledge domains—becomes indispensable in helping the transition to new ways of doing things. Fortunately, the construction industry, as a knowledge-intensive industry, has shown considerable initiative in developing communities and groups to share lessons learned and best practices covering a vast array of subjects. In this sense, the concept of communities of practice (CoP), developed by Jean Lave and Etienne Wenger in 1991 to denote an informal group of practitioners that cluster around a common interest or practice, are particularly useful in grasping the diffusion and propagation of IPD and Lean construction in the North American construction industry. Etienne Wenger and William Snyder define a CoP as “a group of people informally bound together by shared expertise and passion for a joint enterprise” (Wegner and Snyder 2000, 1). In the context of Lean, BIM, and IPD, many CoPs have been developed in order to share best practices and lessons learned. Organizations like the Lean Construction Institute and buildingSMART International and its chapters, among others, have emerged as formal venues to advance and disseminate the growing body of knowledge in these domains. The notion of CoP in the context of this research is particularly important given the impetus that is needed on the part of individuals in

key positions to make the decision to move forward with IPD, Lean, or BIM. Indeed, it was mentioned on many occasions that having access to these CoPs and their members to help frame and provide guidance on how to move forward with these novel project delivery approaches was crucial in the initial decision to go with an IPD approach.

CoPs occur at many levels. The ones described above are international and industrywide. They regroup stakeholders that spread throughout the supply chain and organizational hierarchies. CoPs can exist within organizations and project teams. In fact, they are recommended in the context of any knowledge-based endeavor. In the context of IPD teams, CoPs exist independently from the leadership teams or the implementation teams. In many of the cases studied, CoPs were formed around specific areas of expertise or interest and were seen as essential in ensuring feedback and learning within the IPD team. Learning is one of the key motivations for the formation of CoPs. However, it is important to differentiate the notion of CoP within a project delivery team from that of the project-implementation team or cluster, which are formal project-execution vehicles and have specific tasks and objectives. The main difference between CoP and other types of groups or teams is the lack of a specific goal around which specific tasks and types of complementary expertise are developed and articulated. The CoP is articulated around specific interests that are common to the group and in which learning is one of the crucial motivations.

In this regard, Jean Lave and Etienne Wenger (1991) discussed the concept of situated learning when speaking of CoPs and indicated that they believe most learning happens by doing in social context. Numerous projects in the case studies used formal and informal mentoring for less experienced team

members to learn about IPD and Lean from experienced peers.

2. GOAL SETTING / ALIGNMENT + PROBLEM STRUCTURING

Building projects are unique endeavors. They constantly evolve during their execution and are subject to the competing interests and goals of the various individuals involved in the project delivery process (Anvuur and Kumaraswamy, 2008). A part of the reported strengths of IPD is the fact that project goals and objectives are co-developed by the project team in service of an owner's business needs rather than imposed and self-serving. The goal-setting process is complex due the nature of a building project and requires intense collaboration and expertise to achieve alignment (Franco, Cushman, and Rosenhead 2004). The evolutionary nature of the building project also means that endogenous or internal goals will emerge throughout the project delivery process and will act to supplement the overarching mandated goal—the built asset (Tryggestad, Georg, and Hernes 2010). In this sense, goal setting and alignment play vital roles in the project delivery process (Griffith and Gibson Jr. 2001).

An important part of the goal-setting and problem-structuring process is the sensemaking that is necessary to achieve alignment among project stakeholders. Sensemaking involves identity, experience, and interpretation, an agent's mental world and its enactment in everyday practice (Weick 1995). The building project will trigger and frame sensemaking by providing social cues and feedback, which respectively prime and edit the process (Weber and Glynn 2006). This is crucial as it not only structures the collaborative episode but also, more importantly, it conditions and lays the groundwork for

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Literature Review (3 of 4)

- AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION
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- T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1
- WEKIVA SPRINGS CENTER EXPANSION

other collaborative processes. Understanding and learning are achieved through the act of translating and transforming knowledge by bridging the boundary between semantic and pragmatic knowledge (Carlile 2004). These actions occur between heterogeneous knowledge domains, spurred by concurrent information gathering and sensemaking activities (Lindgren et al. 2008).

Lastly, problem structuring and decision-making are highly complex collaborative processes that subsume most of the actions and interactions that are carried out over a project's life cycle. These processes serve to guide the project's outcomes. The relationship between problem structuring and decision-making is direct: the act of framing a problem implies that a decision has been made (Coyne 2005). They also relate back to goal formation, a continuous process that further structures the collaborative episode (Tryggestad, Georg, and Hernes 2010; Franco 2007). Novel project delivery approaches aim to facilitate and optimize problem solving and decision-making. For instance, BIM allows the development of multiple scenarios to improve transparency in the decision-making process (Schade, Olofsson, and Schreyer 2011). Integrated practices ensure that the right decisions are being made with a product's life cycle in mind and to optimize the whole rather than its parts. Of course, there is a direct relationship between the level of trust, the degree to which a project team communicates and collaborates effectively, and the efficiency of the decision-making process (Chiocchio, Forgues, Paradis, and Lordanova 2011). IPD and Lean aim to facilitate these key team-working elements.

3. CREATING + SUSTAINING COLLABORATIVE TEAM CULTURE

Team culture is a recurring theme throughout the case studies presented in this report. The mention of team culture impacting team performance is common to most, if not all, projects studied. For Edgar Schein, culture "is a powerful, latent, and often unconscious set of forces, that determine both our individual and collective behavior, ways of perceiving, thought patterns, and values" (2009, 14). For many, culture is what differentiates one group from another. Culture is determined by the beliefs, assumptions, and values that prompt behaviors and practices in individuals and teams (Williams, Dobson, and Walters 1993).

In choosing an IPD approach, owners seem to be "contracting" team culture by "legislating" these values, beliefs, and assumptions. It is expected that the resulting behavior is one of trust and respect, which offers psychological safety, among other defining elements of effective teamwork and collaboration. The core tenants of IPD, namely, shared risk and reward and waiver of liability, are seen as effective mechanisms for the development of team cultures and individual behaviors. In essence, the removal of traditional structural barriers, achieved through IPD, is seen to give "license" to collaborate freely. Another formality of team culture and this license to collaborate is allowing project team members to take various perspectives on different issues that arise over the course of project delivery. Perspective taking, as defined by Richard Boland and Ramkrishnan Tenkasi (1995), is the ability of individuals from different knowledge domains, or disciplines, to understand another team member's perspective over the course of project delivery.

That being said, the formality introduced by the IPD contract is not seen as an explicit guarantor of team culture. Most of the participants in the case studies highlighted in this research mentioned not having been directly influenced by the provisions in the contract itself. Yet, many mentioned that the decision to include or exclude a team member in the risk/reward pool or as a signatory influenced the attitudes of individual team members, with those firms excluded from the signatory pool resorting to more "traditional" behaviors. In essence, while the IPD contract was not seen as a cause to establish team culture, its lack was seen as cause for absence of said culture.

Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
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Literature Review (4 of 4, SOURCES)

AKRON CHILDREN'S HOSPITAL, KAY
JEWELERS PAVILION

AUTODESK BUILDING INNOVATION
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MOSAIC CENTRE FOR CONSCIOUS
COMMUNITY AND COMMERCE

QUAIL RUN BEHAVIORAL HEALTH
HOSPITAL

ROCKY MOUNTAIN INSTITUTE
INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS
(LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS
CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

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Glossary/Definitions (1 of 2)

AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION

AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE

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SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

A3

A one-page report on a single 11 x 17 sheet of paper, which uses PDCA thinking as applied to collaborative problem solving, strategy development, or reporting. A3 includes background, a problem statement, analysis, proposed actions, and expected results.

ACTUAL COST

The sum of the total cost of the work actually incurred by the owner, architect, and CM/GC in connection with the performance of all phases of the project, plus the CM/GC's fee. (Integrated Form of Agreement [IFOA] definition)

ALLOWABLE COST

The owner's absolute maximum project cost, based on the project business case, which is the subject of the validation study. (Integrated Form of Agreement [IFOA] definition)

BIG ROOM

A space where all stakeholders in the team can come together and work, typically with visual documentation posted. Shared space can support communication and dialogue, resulting in more efficient and real-time work product, as well as less rework and revision. Big Room set-up, duration, and usage varies.

BUILDING INFORMATION MODEL(ING) (BIM)

Product (model) and process (modeling) of generating and managing building data during the life cycle of a building. BIM uses three-dimensional building modeling software. BIM includes building geometry, spatial relationships, geographic information, and quantities and properties of building components.

CHOOSING BY ADVANTAGES (CBA)

A decision-making system that acknowledges that all decisions

are essentially subjective but guides participants toward objectively discovered and documented facts.

COMMITMENT BASED PLANNING

A planning system that is based on making and securing reliable promises in a team setting.

CONDITIONS OF SATISFACTION (COS)

An explicit description by an owner of all requirements that must be satisfied by the project team in order for the owner to feel that he or she received what was wanted.

CONSTRAINT LOG

A list of constraints with identification of an individual promising to resolve the item by an agreed date.

GUARANTEED MAXIMUM PRICE (GMP)

A cost-type contract where the contractor is compensated for actual costs incurred plus a fixed fee subject to a ceiling price.

INTEGRATED FORM OF AGREEMENT (IFOA)

A multiparty agreement that includes, at minimum, the owner, design professional, and constructor as signatories to the same construction contract. Examples include custom agreements (such as those by the law firm Hanson-Bridgett) and templates (such as ConsensusDocs 300 and AIA-C191 or C195).

INTEGRATED PROJECT DELIVERY (IPD)

For the purposes of this report, we define IPD as the contractual project delivery method used by these project teams that created shared risk/reward structures, fiscal transparency, and release of liability.

LAST PLANNER SYSTEM (LPS)

The collaborative, commitment-based planning system that integrates should-can-will-did planning (pull planning, make-

ready look-ahead planning with constraint analysis, weekly work planning based upon reliable promises, and learning based upon analysis of PPC and Reasons for Variance).

LAST RESPONSIBLE MOMENT

The instant when the cost of the delay of a decision surpasses the benefit of delay, or the moment when failing to take a decision eliminates an important alternative.

LEAN

For the purposes of this report, we define Lean tools and processes as the specific tools and processes outlined by the Lean Construction Institute as well as the variations developed by the teams that share the intent and spirit of those tools.

LEAN SIX SIGMA

Combines Lean focus on value, continuous improvement, and elimination of waste with Six Sigma focus on quality, problem-solving metrics, and minimization of variation.

MEP

Mechanical, electrical, and plumbing systems.

MILESTONE

An item on a master schedule that defines the end or beginning of a phase or a contractually required event.

OWNER'S PROJECT REQUIREMENTS (OPR)

Required for high-performance certifications such as LEED and Petal

PLAN-DO-CHECK-ACT (PDCA)

A four-part process intended to support continuous improvement in a product or process. This is conceived of as a repeated never-ending cycle.

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Glossary/Definitions (2 of 2)

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PLUS/DELTA

Performed at the end of an activity, this review is used to evaluate the activity. Two questions are asked and discussed. Plus: what produced value during the session? Delta: what could we change to improve the process or outcome?

PLAN PERCENT COMPLETE (PPC)

A basic measure of how well the planning system is working, calculated as the number of assignments completed by the time stated, divided by the total number of assignments made for the time stated. It measures the percentage of assignments that are 100% complete as planned.

PROJECT MANAGEMENT TEAM (PMT)

Team composed of representatives from each IPD contract party. Primarily charged with day-to-day decisions. Responsible for shared project schedule, budget, decision-making.

PROJECT IMPLEMENTATION TEAM (PIT)

Team composed of representatives from each IPD contract party and others involved in the project. Members determined by person(s) most responsible for designing, detailing, and constructing the project.

PULL

A method of advancing work when the next-in-line partner is ready to use it. A request from the partner signals that the work is needed and is pulled from the performer. In the pull method, work is released when the other members of the team are ready to use it.

PUSH

The opposite of pull. In push, an order is made from a central authority based on a schedule and advancing work based on central schedule. Releasing materials, information, or

directives possibly according to a plan but irrespective of whether or not the downstream process is ready to process them.

REQUEST FOR INFORMATION (RFI)

A formal question asked by one party of the contract to another party. Typically a request from the contractor to the designer.

REQUEST FOR QUALIFICATIONS (RFQ)

Typically includes relevant previous work, key personnel, and approach to work. In these case studies, often Lean and IPD experience.

RISK/REWARD

Collectively agreed upon amount or percentage of final cost that will be distributed amongst the members of the risk/reward pool if project goals are met. Sometimes called incentive compensation layer (ICL) or profit pool.

SENIOR MANAGEMENT TEAM (SMT)

Team composed of representatives from each IPD contract party, typically the project executive of his/her firm.

TARGET COST (TC)

The cost goal established by the project team as the target for its design and delivery efforts, typically determined after the validation process.

TARGET VALUE DESIGN (TVD)

Management throughout project to assure that the facility meets the operational needs and values of the users, is delivered within the allowable budget, and promotes innovation throughout the process to increase value and eliminate waste.

VALIDATION

A process used to check feasibility of project, matching project team expectation of scope with projected costs. Typical results in setting a target cost and defined scope.

VALUE STREAM

Includes all the processes and activities used to design, produce, and deliver the product or service to the owner.

VALUE STREAM MAPPING

A diagram of the material and information flows needed to bring a product from request to delivery.

VISUAL MANAGEMENT

Placing tools, parts, plans, schedules, measures, and performance indicators in plain view so the system can be understood at a glance by everyone involved and actions taken locally in support of system objectives.

WEEKLY WORK PLAN (WWP)

The commitment-level step of LPS identifying the promised task completions agreed upon by the project team. The WWP is used to determine the success of the planning effort and to determine what factors limit performance and is the basis of measuring percent plan complete (PPC).

WEEKLY WORK PLANNING

The process by which the Last Planner System establishes the plan for the coming period.

Definitions of Lean teams are adapted from the Lean Construction Institute Glossary.

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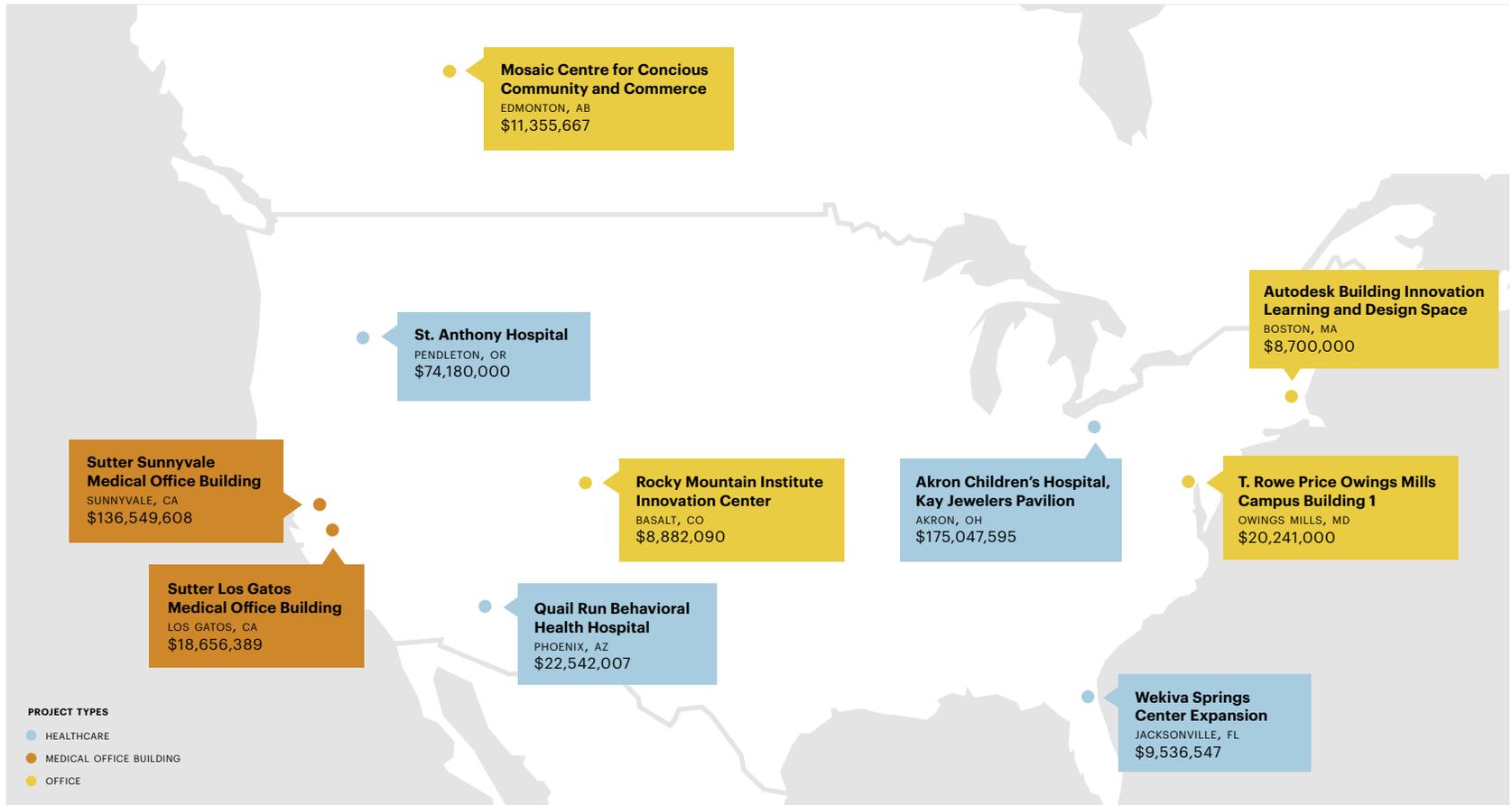
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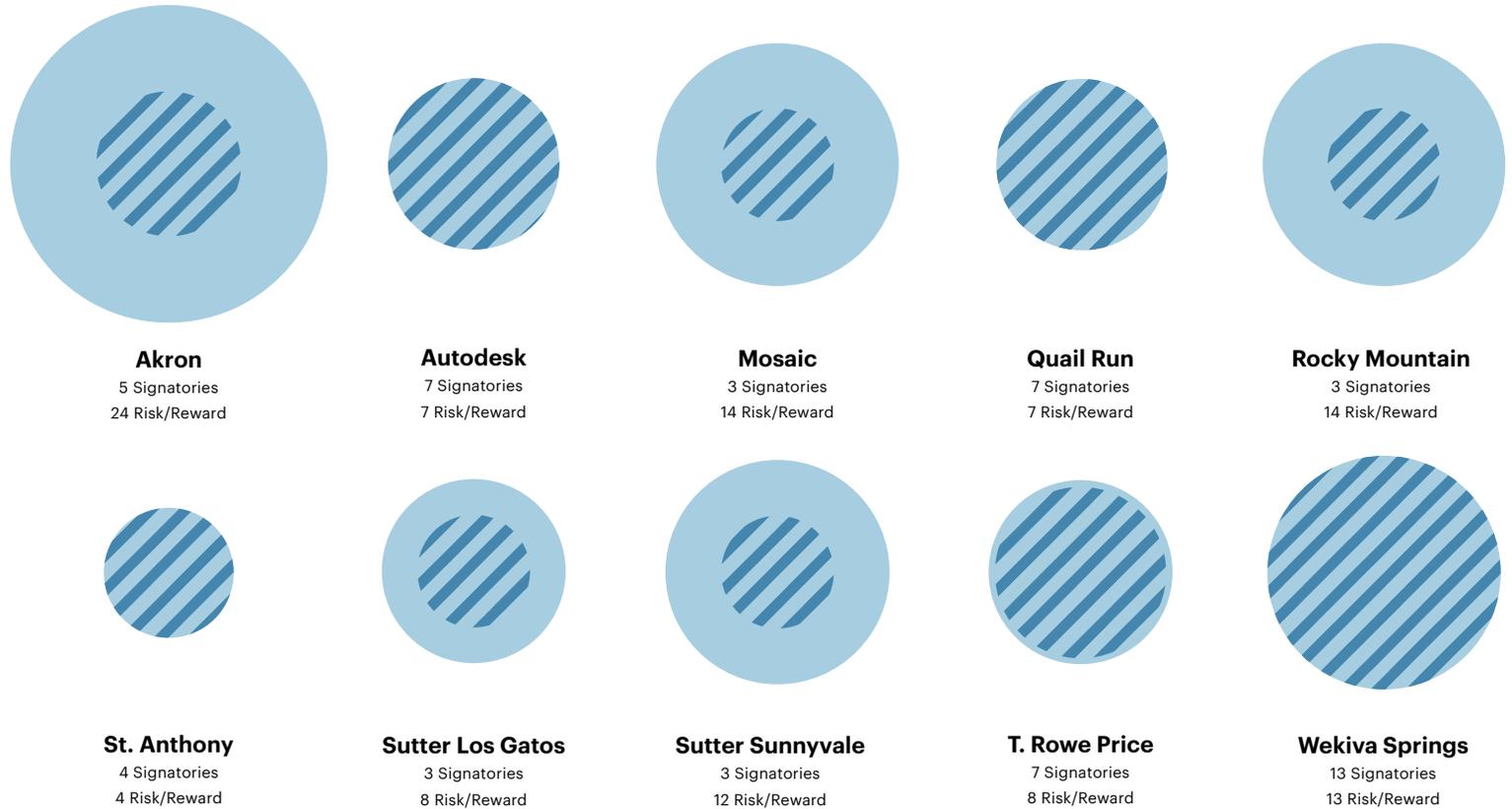
DISTRIBUTION OF CASES ACROSS NORTH AMERICA

The projects chosen for this study were solicited through a call for participation and selected to create a set of cases with diverse geographic locations, market sectors, project types, and project scopes. All of the projects used multiparty agreements and were recently completed.

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PROPORTION OF CONTRACT PARTIES

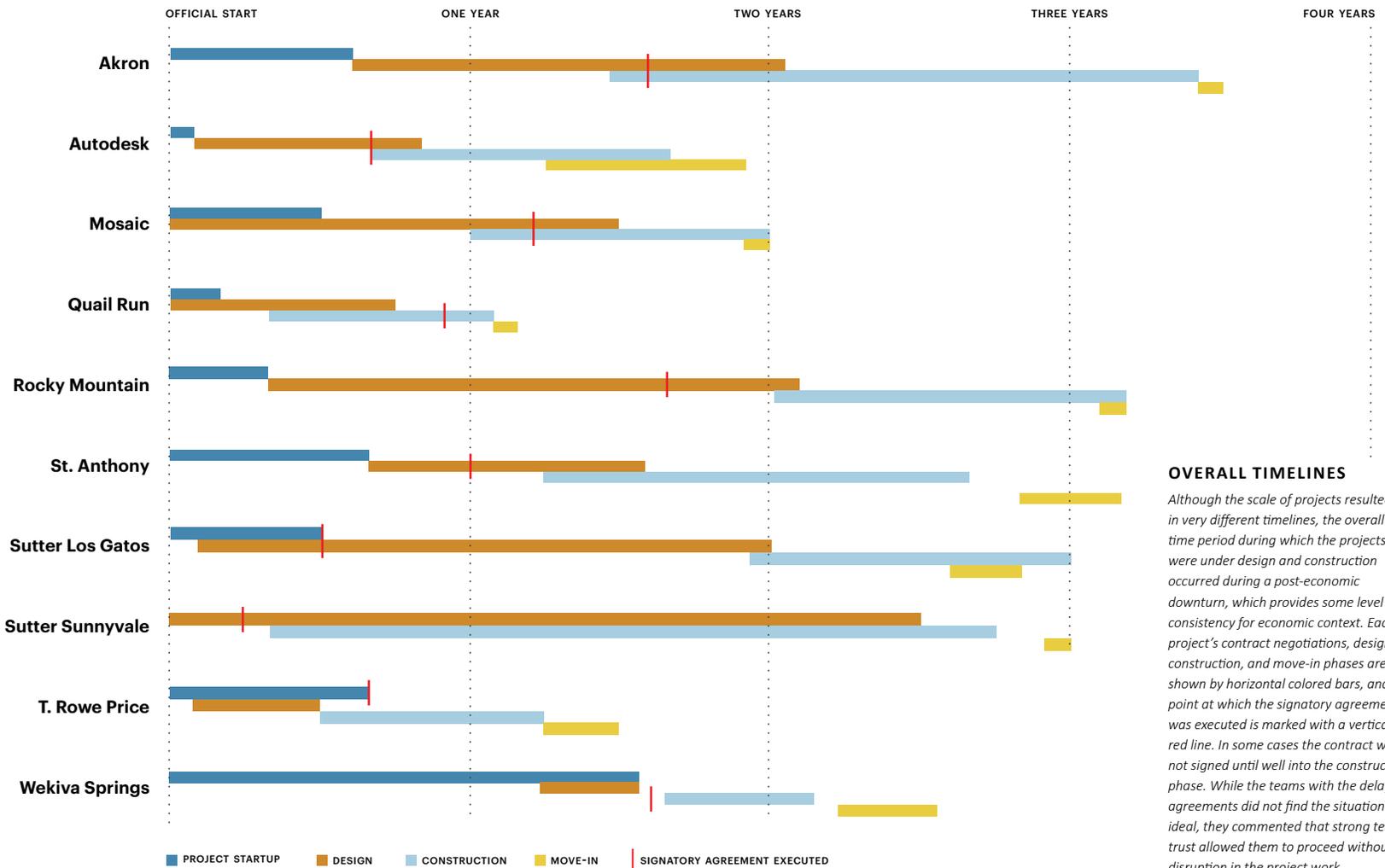
Relative proportion within each team, documenting the number of companies who signed the integrated form of agreement and those in the risk/reward pool. All of those in the original contract are by default in the risk/reward pool. In some cases, additional contract parties joined the risk/reward pool.



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OVERALL TIMELINES

Although the scale of projects resulted in very different timelines, the overall time period during which the projects were under design and construction occurred during a post-economic downturn, which provides some level of consistency for economic context. Each project's contract negotiations, design, construction, and move-in phases are shown by horizontal colored bars, and the point at which the signatory agreement was executed is marked with a vertical red line. In some cases the contract was not signed until well into the construction phase. While the teams with the delayed agreements did not find the situation ideal, they commented that strong team trust allowed them to proceed without disruption in the project work.

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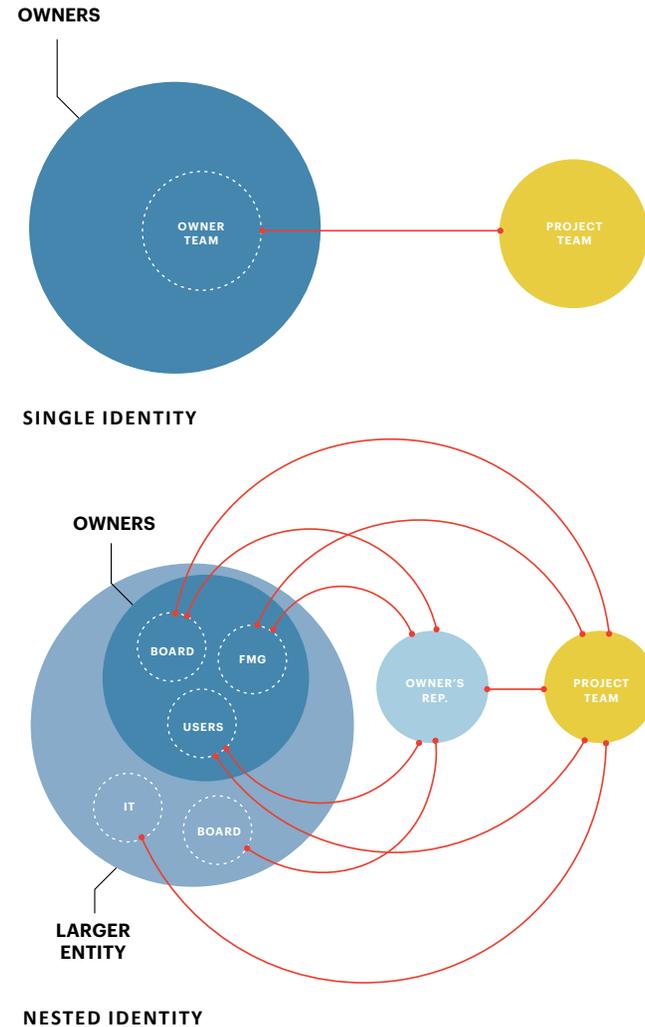
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Owner Identity & Interface

There are a wide range of owner types and organizations in this set of projects. Since decision-making and measures of success are often directly related to the organization of the owner, our research team included a diagram of each owner based on information they provided, applying our own graphic conventions as consistently as we could. Some owners have nested levels of ownership and decision-making, which includes most of the health care projects. From the point of view of the project teams, some owners, such as Sutter and Mosaic, offered a single point of contact with the project team and mediated any input from other entities in the owner group. For other project teams, such as Rocky Mountain Institute (RMI) or T. Rowe Price, multiple entities within the owner group had direct contact with the project team. Our research team found that many of these configurations could be successful. But generally, when the point of contact with the owner was clear, it cultivated strong relationships between the team and the owner, and in cases where the owner's decisions seemed opaque or inconsistent, teams were frustrated and there was an erosion of trust between the project team and the owner.

OWNER ORGANIZATION & RELATION TO PROJECT TEAM

Generic examples of the diagrams the research team created to depict the project team's relationship to the owner. Diagrams use the owner's language around internal owner entities, such as facilities management, building operations, information technology (IT), security, etc. These are noted in the key for each project diagram. Red lines indicate paths of communication.



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Choosing IPD & Lean

In the projects studied, the primary motivation for choosing integrated project delivery (IPD) was often the owner’s frustration with past experiences using traditional project delivery or, for first-time owners, hearing about others’ negative experiences with traditional delivery methods. For the more experienced owners in this set of projects (Autodesk, Sutter, Universal Health Services), IPD has demonstrated its value in supporting their business and project goals, and they are committed to pursuing it on future projects. Having reviewed recent studies of federal projects by the General Services Administration, we know that design-bid-build projects are more likely to fail in meeting cost and schedule goals and more likely to lead to litigation than any other delivery type. Data also shows that IPD, Construction Manager at Risk, and design-build have proven advantages in delivering buildings with reliable costs and schedules. Interestingly, comments from the owners regarding their choice of IPD were often less focused on cost and schedule and more focused on reducing conflict and achieving a positive culture. Based on previous data and on the analysis of projects in this set of cases, IPD project teams are notably unified in their team-first or project-first attitude as well as in exhibiting resilience by managing change and planning for complexity. The existence of the shared risk/reward pool was most frequently cited by teams as the reason for setting up expectations for a shift in individual attitudes and project cultures. While the risk/reward pool may have set up the initial shift, sustained culture change required multiple means of support. The work to establish a strong culture was extremely valued, most team members cite culture as the main driver for project success. Participation in this study was voluntary, so it represents a small self-selected group. The expected benefits of IPD (less conflict, more reliable schedule and budget

outcomes) were typically achieved, but there were often additional benefits, including tangible cost or schedule savings achieved by collaborative efforts and intangible benefits offered by a strong team culture, leading to projects being described as “fun,” “exciting,” or “the highlight of my career.”

For many of the owners and teams, the choice to use Lean tools and processes was seen as an integral decision in choosing to pursue IPD. Most owners, regardless of their previous project delivery experience, believed that IPD facilitated the use of Lean practices. In two cases (Akron and Mosaic), owners who used Lean extensively for their own business models believed IPD was the logical delivery method to extend their Lean thinking to a building project. We saw many owners and teams that conflated Lean and IPD and used them interchangeably. Since Lean and IPD are complementary, it may not be useful to draw a distinction between the two. However, for the purposes of this study, we define IPD as the contractual project delivery method used by these project teams, creating shared risk and reward and a release of liability. We define Lean tools and processes as those intended to maximize value by reducing wasted time, wasted movement, and wasted human potential. The way we believe IPD and Lean worked for these teams is that IPD provided the contractual environment to collaborate (shared incentive pool) and some of the mechanisms for trust (development of the contract, open-book transparent finances, shared understanding of each other’s business objectives); Lean provided the means by which to focus the team’s energy to collaborate effectively for cost, schedule, and other goals that could be developed and aligned using Lean tools. Lean tools and processes provided the most consistent metrics for team productivity and progress toward project goals, but we also saw examples of teams developing customized worksheets,

dashboards, or matrices that also provided mechanisms for measurement. All teams, regardless of their previous Lean or IPD experience, emphasized the importance of education and self-awareness and a commitment across the team to creating and sustaining collaborative culture.

TAKEAWAYS

- Owners’ goals driving the choice to pursue IPD were universally met.
- Common owners’ goals: cost and schedule predictability, teams working without conflict.
- Owners and teams conflated Lean and IPD, often perceiving them as one and the same.
- Our research team found IPD set the terms of collaboration and Lean provided the means.
- Core team members without experience in IPD found value in learning about it as a team.
- Core team members with IPD experience wanted to advance the use of IPD in the building industry and understood their mentor role in the team.
- Owners that had extensive experience with Lean in their internal operations and industries believed IPD was a direct extension of their company’s Lean values.
- Owners that had extensive IPD experience are interested to find ways to use IPD more expediently with fewer customized contractual terms and faster team building.

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Team Selection

Our research team documented the owners' processes for selecting the project team members. Several owners relied heavily on previous relationships, sometimes without a formal request for proposal (T. Rowe, Sutter) and sometime with a curated invitation to submit proposals (St. Anthony). There were cases when the first project team member was chosen based on established relationships, with subsequent members chosen using a more formal process (Mosaic). Finally, there were examples of very formally structured proposal evaluations. Autodesk and RMI developed their own processes; Akron and Quail Run used the Lean process Choosing by Advantages (CBA). The owner of Akron—among the projects that were the first in their market to use Lean and/or IPD—took the unusual step of hiring one national and one local company for the contractor and architect role, believing the pairing would benefit the local building community. For those projects built in remote areas (St. Anthony, RMI), consideration had to be given to the local building community, which would be invested in the project but which might not have the expertise to execute a project with the aspirations and scope set forth by the owner.

TAKEAWAYS

- Owners who used a formal selection of the companies for the project team developed criteria based on goals and collaborative and/or Lean culture.
- Sometimes selection criteria included experience with IPD and/or Lean, but there were some markets for which there was a very limited experience pool (Mosaic, Akron, Wekiva, St. Anthony, RMI). Willingness to participate in and demonstrated past collaboration served as a proxy.
- For some owners with Lean experience, the Lean tool CBA was used for team selection.
- Team selection of the "right people" was seen as a critical element of success.

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Developing Contract

All projects in this report used some form of IPD agreement with a shared risk/reward pool that included more than three parties. Most projects used Lean tools and processes, although there was great variation in implementation. There was variation in the degree to which the agreements released liability: most were complete release between the signatory companies; others were no different than conventional contracts in which the owner reserved the right to pursue litigation (St. Anthony, Sutter-Los Gatos). The project team involvement in the development of the contract ranged from minimal to highly interactive. The teams who collectively invested time in developing the contract (Akron, Autodesk Mosaic, Quail Run, RMI, T. Rowe, Wekiva,) believed it established a strong foundation of trust and respect, and a deeper understanding of the business needs and practices of their partners. It was striking how many times team members from all of the projects dismissed the contract's impact during the design and construction process—in most cases the contract was rarely referenced after the document was executed. However, in spite of team members' expressed skepticism of the contract's impact, the time developing the contract was clearly valuable in building the team itself and setting the expectations for close collaboration and mutual respect. And perhaps equally notable were several examples of a project team's resilience when they were able to resolve significant challenges with all team members working together without finger pointing or litigation. Since nonresults are also findings, we believe that the teams may be discounting the ability of the contract to protect the teams from outcomes that would have hindered success.

TAKEAWAYS

- For the teams who were heavily invested in collaboratively developing the contract, the contract discussions were structured to serve as training about IPD, and the teams believed that this contract-development process formed the foundation for trust, respect, and collaboration.
- Many teams commented that the overall concept of the IPD contract was accessible, but implementation of the terms was sometimes unclear.
- Most teams did not comment on insurance, but the Akron team found the owner-provided "full-wrap" project insurance to be liberating and fundamentally supported collaborative behavior, with one subcontractor estimating it saved the project team \$1.7M.
- While many teams downplayed the role of the contract in the successful execution of the projects, the research team concluded that the IPD agreements bonded the team as a unit, thereby increasing their resilience in the face of challenges and protecting the teams from entering into a cycle of blame and defensiveness.

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Developing Parties

All teams in this report faced decisions about signatory companies: how many and which ones to include. Involving more parties has two clear advantages: it brings diverse voices to the table, and it increases the number of voices coming from partners who have incentive to set the project goals as their highest priority. The disadvantages are largely administrative, since coordination and communication needs increase with a greater number of involved parties. However, even before one considers the management capacity of the owner, the ideal size and proportion for the signatory pool relative to the overall project team is inconclusive—this is a topic for future research. Teams were divided on whether there was an observable difference in the culture or behavior of those in the signatory pool compared to those outside of the pool. Most teams reported a clear difference, but others believed that the collaborative nature of the core team spread to all members. The research team heard several comments from designers, owners, and constructors about how the incentive pool should be considered differently for architects and engineers. The ability of architects and engineers to affect the cost of the project is profound, but since their involvement is earlier in the project delivery process, the actual cost savings is typically not known until the actions of the builders are complete. We found that the motivation of architects and engineers to collaborate is not increased by having their profit held for the duration of the project, since it is usually a far lower amount than the constructor's, and their active participation often ends before all the final costs are known.

TAKEAWAYS

- All projects used some form of IPD agreement, with more than three parties in the signatory pool, but there was variation in language around Lean and other project management processes, as well as different degrees to which collaborative language, such as trust and respect, was included.
- The process of developing and understanding the contract is valuable for establishing a foundational team culture, including appreciation of the differences between partners' business practices.
- Shared management of contingency and incentive pools could be complex, and an experienced contractor suggested that simulations of how the pools actually worked in practice would have been valuable.
- Differences in the nature and timing of work of architects and engineers compared to those on the construction side suggest that handling of the incentive pool may need to be treated differently depending on stakeholder group.

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Champions

In our past research, we have seen that having a champion for the use of IPD or Lean can be a key to successful implementation. The champion may or may not be the leading expert but has strong faith that the use of IPD or Lean will be valuable and finds opportunities to support its use. As one might expect, champions are often owners or in upper-management positions, but we are increasingly seeing that championing can be done at many scales, by many people. A lack of any champion can be a challenge for a team, since the pervasive nature of IPD and Lean (and building information model [BIM]) can be overshadowed by the day-to-day concerns of meeting the cost and schedule without regard for larger goals the team established as important. In almost all the projects in this study, the owner was seen as a champion for IPD and Lean. The exception was St. Anthony—the owner’s representative and the volunteer advisory board were the champions. Since the make up of the owner varied greatly, the championing of IPD and Lean was sometimes led by an individual (Mosaic, Sutter, T. Rowe) and sometimes led by a broader group within the owner entity (Akron, Quail Run, RMI, Wekiva). In the case of Autodesk, championing of IPD was strong by some parts of the owner group, but the team perceived the lack of a champion as a challenge.

TAKEAWAYS

- Champions support team success, and championing can come from more than one person and from a variety of levels and areas of expertise.
- Distributed championing was effective for some teams.
- When naming their champions, team members often conflated IPD and Lean. The research team observed that all teams had an IPD champion but not all had a Lean champion.
- Champions were sometimes inexperienced in Lean and/or IPD but were seen as having faith in their effectiveness and were willing to invest resources to support the work to achieve Lean and IPD.

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Decision Structure

This section of the report outlines the teams' decision-making processes and structures that support them. For all of the teams, their IPD agreement lays out the decision structure; however, the number of decision bodies, their make up, and the nomenclature varied. The predetermined structure was generally sufficient, but teams evolved their processes. In the case of Autodesk, a new structure was added. Effective decision-making is marked by reliable decisions that are not often reversed and effective meetings that involve the right people. It's challenging to achieve effectiveness at all levels, and a team may need time to develop strong decision-making skills. The research team heard many comments about the balance between fluid decision-making and the need for sufficient documentation, in case issues arose that needed referencing or communicating. A3 was the most commonly mentioned mechanism for formal documentation, but many individuals believed it was too cumbersome to justify use except for decisions with a major impact on the project. The RMI and Mosaic teams developed matrices based on owner goals and team and project values that assisted the team in making decisions effectively with minimal input from the owner.

Decision-making is also related to communication and team culture as described in team outcomes. There are several examples of the relationship between team culture and decision-making: a Quail Run trade partner commented that decision-making improved when the team realized they had to take ownership of decisions and not wait for the owner to tell them what to do. Another example came from Wekiva's general contractor who noticed they had to shift their mindset from being the company in charge of construction to embracing the role that they were but one vote among a team of partners. In an example of how the owner's culture can

affect decisions, the architect from Akron commented that the owner's culture empowered front-line hospital staff to make decisions, which made their input very effective and led to positive user satisfaction. When surveyed, the project teams were all quite positive about decision-making. Respondents generally believed that most decisions were made with the involvement of the right people working collaboratively in a timely way, so that options could be considered, resulting in decisions that were reliable and stable (unlikely to be reversed). Autodesk's project team had the most variation in responses and scored slightly lower overall than the rest of the projects.

TAKEAWAYS

- A challenge for the teams was finding a balance between the inclusion of all signatory parties in collaborative decisions with determining the appropriate amount of time of participation of team members who were not directly involved with a particular decision.
- The research team found that there is a connection between team culture and effective decision-making.
- The research team defined an effective decision-making structure as one that supports reliable decisions by including the right people (those whose input and expertise is key).

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On Board & Off Board

The information in this section relates to the on-boarding of new team members who joined after the team's initial formation and training. The facilitation of early planning is in the Resources & Facilitation section. Personnel changes can occur through normal project turnover or phase changes, or they might be due to poor matches with the project team culture. Understanding how personnel can fit within a team culture is challenging. For the projects that used intensive workshops in the early phases, adding people to the team required a process of introduction to the project, the culture of the team, and the difference between how an IPD/Lean team works compared to typical delivery methods. Many teams distributed the on-boarding, where each company managed the process for their new team members, (T. Rowe, RMI, St. Anthony, Autodesk); however, for other teams on-boarding was a constant training process for new team members and also optional additional training for continuing members (Akron, Wekiva, Mosaic, Quail Run). Videos, infographics, and PowerPoint presentations were commonly cited as training materials.

TAKEAWAYS

- On the teams in this study, removal of team members was rare, though it did occur. Many teams reported coaching or using other interventions that prevented a situation from becoming serious enough to warrant removal.
- On-boarding seemed to be successful regardless of the degree of formality of the on-boarding process, although many team members commented that on-boarding could have been improved.

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Clarity of Goals

Remarkably uniformly, all owners in this study believed their goals were extremely well met. It's notable that there was a range in the degree of ambitiousness of owners' goals: some owners limited their goals to pragmatic issues, such as reliable budget and schedule, others had aspirations to use the project as a model to lead or change the industry. Alignment around the owner's goals was marked by clear communication, a team culture that placed the highest priority on the project agenda, identification of issues, and predicting areas of complexity. The most successful teams were able to use their alignment to create actionable and measureable goals. In multiparty agreements, the diversity of participants can make it difficult to align as a team and challenging to resolve the agendas that each party brings to the project. This section addresses how owners communicated their goals, how well the teams understood the goals, how they achieved alignment around the goals, and evidence of how that alignment impacted their ability to address issues and plan for areas of complexity. The teams referenced documents that recorded their progress in meeting the owners' goals, such as the owner's project requirements (RMI), dashboard (St. Anthony), and key performance indicators (Autodesk). Validation studies were a touchstone for most of the project teams that did them (Akron, RMI, Sutter-Sunnyvale, Sutter-Los Gatos). There were two examples of the validation study not being considered universally positive: Mosaic's validation was useful but, since some issues were not fully resolved, was less successful in anchoring the team; Wekiva's verification report was helpful to some on the team, but the owner did not perceive value. The timing of the verification study was typically early, but its completion relative to the contract varied greatly. Wekiva's owner believed the contract signing

was critical to do before the study; others believed the study should be done as soon as possible, especially in setting the target cost for the contract.

When surveyed, all the teams characterized the owner or owner's agent as "highly involved." When asked about the clarity and communication of the owner's goals, other than cost and schedule, responses from the Autodesk and Los Gatos project teams received the most mixed results but averaged over 3. (1=ambiguous, not communicated; 3=somewhat clear goals, somewhat effectively communicated; 5=explicit and unambiguous goals, very clearly communicated.) This was a striking contrast to other project teams' ratings of the owners' goals and their communication, with majority of scores being 4s or 5s. The material in this section of the research relates to the ways the teams aligned around goals and took actions to achieve them.

TAKEAWAYS

- The owners' goals were extremely well met across all the projects.
- Validation studies became touchstones for most of the teams that had them, though there was some debate about the ideal timing to set the target cost relative to the completion of the validation and to the contract execution.
- When surveyed, all teams characterized the owner or owner's agent as "highly involved and responsive."
- Cost and schedule reliability were the two most common goals, but others included the highly aspirational goals of changing the industry or becoming a model for future change.
- Regardless of the level of ambition of the goals, the teams worked to align their agendas, find ways to communicate, and predict areas of complexity in the project.
- Documents that laid out the owners' goals (key performance indicators, dashboards, etc.) were helpful for their team to measure their progress.

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Resources & Facilitation

Since all of the teams in this study had project team members of different levels of expertise with IPD and Lean, some form of support was needed for team members who were new or less experienced. Support for project teams took many forms. One of the most common was a formally structured intensive workshop led by experts in IPD and/or Lean. Also common was informal coaching by experts internal to the project team or from within one of the partner companies. Less common, but effective when used, were shared readings and discussions. Two teams used early assessments intended to reveal the differing strengths and styles of individual team members. A couple of teams used team-health assessments throughout the design and construction process. Teams varied in their response to the training: some attributed their success to early formal training (Akron, Mosaic, Quail Run, RMI, T. Rowe, Wekiva); others believed their successful culture was the result of daily interaction and informal coaching or self-policing. All teams commented on the struggle to overcome the inertial pull of reverting to traditional roles and actions. They emphasized the need for self-awareness as well as some kind of mechanism to change behavior. Examples include simple reminders by peers done privately, calling out non-IPD or non-Lean behavior in front of others, or reconvening the team for additional formal training.

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USE OF RESOURCES

Training

- 30% of the teams had internal experts who led multiple Lean and IPD workshops throughout the project duration.
- For the remaining 70% of the teams, outside consultants were brought in for an early workshop and a follow-up.
- Typically, the teams combined Lean and IPD training, although there were a couple of projects that clearly separated the topics.

Outside influences

- 40% of the teams were influenced by a group reading and discussions of a book.
- 20% of the teams commented that it was helpful to attend a Lean or IPD conference together.

Personality assessments

- Only two projects used personality assessments for team members, but both found it very effective.

Specialized resources used

- 30% of the teams used video to study wasted time or effort.
- 20% of the teams used full-scale mock-ups of assemblies or circulation.

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Tools & Processes

This section covers tools used, including many that evolved from “pure Lean” processes. This section complements the Lean Effectiveness section of this report. Several teams emphasized the effectiveness of visual coordination (Akron, Mosaic, Quail Run). Location-based planning was cited as effective (Autodesk, Sutter-Los Gatos, Sutter-Sunnyvale). Project dashboards were helpful to some teams (RMI, St. Anthony, T. Rowe), but at least one team (Quail Run) found that a dashboard took more time than warranted for its value. All teams used pull planning, which was effectively on all of the projects in this report and universally cited by team members as valuable. Some teams reported resistance to the time required for pull planning. However, in most cases resistance was quickly overcome after realizing the schedule savings or anticipation of conflicts. Overall, the metrics most commonly mentioned by teams as effective around budget and schedule relate to Last Planner System, including plan percent complete (PPC) and reliable promising.

All of the teams rated themselves high or medium-high in the use of tools that supported learning and metrics, such as project-success metrics, project conditions of satisfaction. Similarly high ratings were seen for tools and processes to manage cost (A3, target value design, CBA, etc.). Some teams noted that while they may have used a tool, it was not always effective, commenting that the tool was mostly discussed in meetings but had little effect on the day-to-day operations. The use of tools also evolved over the course of the project: project teams found some tools well worth investing the time to maintain, while the use of others tapered off due to diminishing returns or lack of a champion. The research team noted cases where specific metrics became consistently useful tools to measure progress toward the owners’ goals (Akron,

Quail Run, RMI, St. Anthony). When surveyed about metrics measuring specific team behaviors, such as accountability, effective meetings, level of collaboration, the Akron and T. Rowe teams consistently reported that metrics were used for a broad array of team outcomes. Autodesk consistently reported metrics were not used, and other teams were mixed. A lack of metrics should not be confused with a lack of achievement: all the teams perceived that they had achieved very high levels of collaboration, accountability and trust. All teams that used metrics believed that they had a positive or very positive impact on the team and on individual behavior. Very few respondents believed there was no impact, and none reported negative impact. Responses related to the achievement of goals were fairly mixed, indicating that metrics were often “stretch” metrics, in which very high achievement is rare. Comments in interviews stressed the importance of the metrics being collaboratively agreed upon and meaningful, based on the teams’ ability to manage themselves, not on outcomes beyond their control.

Probably the most resourceful and effective stories about a tool came from Sutter-Sunnyvale’s contractor, who adapted a conference-room-scheduling software for suppliers to schedule deliveries. The result was higher efficiency for project team and suppliers, and, most critically, solved the neighborhood complaint of excessive idling and off-hour deliveries on the job site.

USE OF TOOLS

Pull planning

- All of the teams used pull planning.
- 80% found it was extremely effective.

Last Planner System

- The full Last Planner System (including pull planning, PPC, workplans, first run studies) was used by 70% of the teams.
- Of teams that used it, only 50% believed they fully implemented it and saw clear benefits.

Dashboards

- 40% of the teams used dashboards.
- Most teams found it useful.

Visual Documentation

- 50% of teams used visual documentation.
- Most teams found it useful.

Plus/Deltas and A3

- 70% of teams used plus/deltas and A3.
- Of teams that used them, only 40% found them to be effectively and consistently used.

Customized tools

- Three of the teams used internal resources to modify a commercial tool to meet customized needs.
- In each case, the team found those tools to be profoundly helpful.

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Lean Effectiveness

The adoption of Lean tools and processes by the building industry is uneven at this time. The teams' responses to queries about Lean indicate an uneven level of understanding within the industry. Perhaps because of this variation, we saw mixed results when teams applied Lean tools. In our interviews, we found that there is confusion about the distinction between IPD and Lean, especially in regard to how training for one may or may not prepare the team for implementing the other. Additionally, there were many examples of teams that found Lean tools or processes ineffective, possibly because they did not follow the best practices recommended by the Lean Construction Institute or did not have a champion who provided the needed support. For example, teams' responses to A3, CBA, and Plus/Delta was extremely mixed, with some teams finding one cumbersome and the others very effective and other teams believing the opposite. Additionally, teams evolved their uses of tools over the course of the project, finding some tools more effective early in the process and others later. Again this was very mixed, with strong and contradictory preferences expressed when the researchers compared teams.

The research team observed that Lean was predominantly discussed in terms of improving the construction process, with very little application to design or involvement by designers. The research team found that in the surveys, those teams with high Lean-implementation experience (Akron, Mosaic, T. Rowe, Wekiva) also had strong collaborative team cultures, good communication, and positive outcomes. Interestingly, these teams tended to rate their project's complexity lower than typical, which may have been the result of lower complexity or that the Lean processes helped to clarify and make the project appear less complex.

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TAKEAWAYS

- Industry adoption of Lean tools and processes is uneven and weighted toward use in construction rather than design.
- Teams with heavier emphasis on Lean construction were more likely to have slightly more positive team and building outcomes.
- Teams with heavier emphasis on Lean rate their projects as less complex. This may be perception, since Lean tools and processes can make tasks clear and straightforward.

LEAN TOOLS AND PROCESSES

- Team Formation:** Team Forming, Team Initiation, Experienced Lean Partners, Early Stakeholder Involvement, Team Partner Selection, On-boarding
- Team Development and Effectiveness:** Facilitation, Coaching, Individual Assessment and Development, Team Assessments, Continuous Reflection
- Goals/learning/metrics:** Conditions of Satisfaction, Success Metrics, Retrospectives, Plan-Do-Check-Act, Continuous Improvement, Plus/Delta, Dashboards
- Physical/Virtual Workplace and Meetings:** Co-location, Big Room, Daily Huddle, Agenda Development, Visual Management
- Cost and Decision:** Cost Forecasting, Collaborative Budget Management, Conceptual and Continuous Estimating, Risk and Opportunity Register, Target Value Design, Cluster Groups, Set-based design, Choosing by Advantages, A3 Thinking, 5Whys, Value Stream
- Project Management:** Last Planner System, Reliable Promising, Burn Rate Management, Work Structuring

	Lean Tools and Processes					
	Lean Team Formation		Goals	Workplace and Meeting	Cost and Decision	Project Management
	Team Formation	Team Development				
Akron	●	●	●	●	●	●
Autodesk	○	○	○	●	●	○
Mosaic	●	●	●	●	●	●
Quail Run	●	●	●	●	●	●
Rocky Mountain	●	●	●	●	●	●
St. Anthony	●	●	●	●	●	●
Sutter Los Gatos	●	●	●	●	●	●
Sutter Sunnyvale	●	○	●	●	●	●
T. Rowe Price	●	●	●	●	●	●
Wekiva Springs	●	●	●	●	●	●

- Done well, used often, helpful to the team
- Done, but only somewhat helpful or mixed comments about its effectiveness
- Did it, but it was not seen as particularly effective by most of the team
- Did not have it

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
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BIM

All projects in this report used BIM to some extent. For the most part, BIM was effective for clash detection and coordination but only in rare cases was it a platform for deeper levels of collaboration. All teams found that time invested in BIM was valuable, even for the projects with relatively straightforward technical goals. All teams responded to the survey that their BIM expectations were met or well met, with RMI, Sutter-Sunnyvale, Wekiva, Autodesk reporting their expectations were well met or extremely well met. RMI was successful in using energy models coordinated in parallel with BIM. The Akron team noted particular struggles coordinating multiple BIMs. The management of BIM was typically handed off from the architect to the contractor, but in a few cases, a consultant or subcontractor was designated to lead the BIM efforts. Autodesk's project stands out from the others in this report for its extensive use of BIM and other software. This project team nearly unanimously characterized the level of BIM use as extensive and customized, and they reported the highest level among the projects in this study for the model's reliability, precision, and usefulness.

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TAKEAWAYS

- For the most part, teams set modest goals for BIM to be used for clash detection and coordination and successfully achieved them.
- Autodesk had much more extensive BIM goals and benefited the most among all the teams in the study.
- RMI found great benefit in energy models that were not coordinated with BIM.
- Trying to coordinate multiple models was challenging for Akron.

BIM
Defined as the use of software to create a model or models that include building geometry, spatial relationships, geographic information, and quantities and properties of building components, and provides the platform for simultaneous conversations related to the design of the building product and its delivery process.

	BIM
Akron	●
Autodesk	●
Mosaic	●
Quail Run	●
Rocky Mountain	●
St. Anthony	○
Sutter Los Gatos	●
Sutter Sunnyvale	●
T. Rowe Price	○
Wekiva Springs	●

- Done well, used often, helpful to the team
- Done, but only somewhat helpful or mixed comments about its effectiveness
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Workplace

Some form of physical co-location and virtual coordination was used by all teams. Physical co-location was most difficult on the smaller projects that had team members split between many other projects but also was challenging on larger projects when the logistics did not align well with physical co-location. Those teams who were able to successfully co-locate pointed to the shared work space as a critical component of building their culture and often stated that the beginning of the co-location was the turning point when they gelled as a team (T. Rowe, Mosaic, Akron, Quail Run). Success did not always mean full-time co-location, and there were times when one of the partner's main offices was proximate enough that they could function as a co-located team. Borrowed space, noisy space, fragmented time, or delayed project starts were the most common reasons cited for unsuccessful co-location, though most of the time corrections were made that resulted in effective co-location experiences (T. Rowe, Autodesk). The teams who successfully co-located believe that it reduced paperwork, reduced time for decisions, and led to better decisions, with input from the right people. Visual reminders of pull scheduling were commonly cited as valuable to communication. Other than the obvious logistical challenges of setting up a co-location space, team members were unanimous in believing it was valuable. Only a few project teams were able to co-locate at or near the site from the beginning of the project (Mosaic, Akron), but many others used temporary spaces hosted by one of the partners. Some of the few negative comments were privacy issues (when team members were sharing space but working on other projects) and the perception of "wasted time" or "excessive time" (when work in the shared space did not seem to be focused or included companies not directly involved with the topics under discussion). Comments from those more positive

about co-location believed that serendipitous conversations often led to the most positive outcomes.

TAKEAWAYS

- Teams who were able to successfully co-locate believed it was effective and had a positive impact on the team.
- For most of the teams, it took some time to establish an effective co-location space, and in these cases teams commented it would have been beneficial to have a well-functioning space earlier in the process.
- There was a perception among some team members that there was "wasted" or "excessive" time by having so many people working in a Big Room setting, but others believed proximity and participation in conversation topics that did not directly impact their work provided the most opportunity for positive outcomes.

CO-LOCATION

Defined as a work space shared by all stakeholders, providing the team with visual documentation reference, and opportunity for formal and informal interaction Actual implementation of co-location ranged from a permanent dedicated space used by all of the members of the risk/reward pool to an ad-hoc space or space shared only by the contractor and trade partners.

	Co-Location
Akron	●
Autodesk	●
Mosaic	●
Quail Run	○
Rocky Mountain	◐
St. Anthony	◐
Sutter Los Gatos	◐
Sutter Sunnyvale	○
T. Rowe Price	◐
Wekiva Springs	●

- Done well, used often, helpful to the team
- ◐ Done, but only somewhat helpful or mixed comments about its effectiveness
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Team Alignment

This section of the study documents the impact of financial incentives and other contractual terms on the project team as a whole. The inclusion of their company in the incentive pool was cited by team members as having a direct impact on individual behavior, typically in empowering or motivating team members to speak up about partners' business practices that would not normally be in their purview. Comments were sometimes prefaced by statements like, "If it weren't for the fact that it's my money too, I never would have said/done..." Trading scope for the benefit of the project was commonly found in these projects. More information is described in Alignment & Goals- Collaboration.

The Sutter-Sunnyvale and Sutter-Los Gatos contractors both noted that companies in the incentive pool seemed more willing to pursue Lean processes. Autodesk's architect characterized the contract use as "always a carrot, never a stick." Gaining a deeper understanding of partners' business models seems to be commonplace when working in IPD teams, and this usually leads to a greater appreciation for the challenges each individual company faces in meeting the project goals.

Unquestionably, team members spent more time in meetings, collaborative planning, and fiscal reporting than in traditionally delivered projects. Companies varied in their ability to predict and budget for the additional time. The shift in amount, timing, and, sometimes, level of personnel devoted to the project were topics that many teams discussed. Most teams commented that the investment of time early in the project paid off with less time spent later. Challenges also existed around managing the cash flow of fees in IPD projects. Final profit numbers are reported in the Team Outcomes section of this report.

Transparency can be difficult to achieve with conventional tracking systems and a conventional mind-set. One of the most powerful examples of this was when the mechanical trade partner for Sutter-Los Gatos was asked by an inexperienced general contractor to shift numbers around to make the fee balance with the hours. He replied that he could do that but that "it would not tell the story of what really happened" and allow for the learning and transparency desired in the Lean and IPD model.

TAKEAWAYS

- IPD teams gain deep understanding of each other's business practices, leading to greater appreciation of each other's challenges in meeting project goals.
- Collaboration beyond the typical was most often seen by parties who participated in the incentive pool, sometimes in great contrast to those who were not participating, although there are examples when the collaborative culture extended outside the incentive pool.
- Time invested in IPD projects is different than in typical delivery, not only in the larger quantity of up-front hours but also in the timing and the level of personnel required. There are time-saving elements, but they can be difficult to track. Additional time can be managed with sufficient planning, fiscal transparency, and clear contractual terms around how time is compensated by all members of the team.
- Transparency can be difficult to achieve with conventional tracking systems and conventional mind-sets.

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ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

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Collaboration

This section of the study relates directly to the clarity and communication of the owner's goals. The research team focused on how the team aligned around the owner's goals and how they translated that alignment into actions as a group or as individuals. Several teams produced documents based on their understanding of the owner's goals and how it would inform their actions. More information can be found in the Tools and Processes section. These included a decision matrix (Mosaic) and conditions of satisfaction (RMI), which allowed the teams to measure their progress toward achieving the owner's goals.

We documented behavior that departed from the silo mentality typically observed in traditional delivery methods. Many team members indicated, specifically, that the project-first or team-first attitude of IPD projects made them feel comfortable in doing or saying something they would not normally. Most of these examples were crossing boundaries between signatory companies or trades (designer/contractor, subcontractor/engineer) and, occasionally, bridging outside the team for trade partners, designers, or owners to interface with manufacturers in ways that typically would be mediated by the general contractor. When it was possible to measure, the benefits of this collaborative behavior often yielded significant cost and/or time savings. Teams also cited examples of setbacks that resulted in the team dramatically reducing the negative or creating a positive impact on the schedule or budget: RMI had a two-month delay with the window manufacturer that the team managed without major a negative schedule impact. Mosaic had a misunderstanding about a shear wall that was resolved without significant budget implications. Sutter-Sunnyvale realized a \$.5M savings from a structural revision. In all these cases, as well as smaller-scale examples, the team attributes their success in

anticipating problems and managing issues to their ability to collaborate.

Several owners were able to increase the project scope with value-add items because of cost savings achieved by the teams. While this was a positive result, managing the change, too, could be challenging in terms of its implementation and the scope of work. T. Rowe's team tied dates to critical decisions; RMI's engineer commented that the time they spent to implement the value adds was equivalent to 10% of their total fee, costs that without the fiscal transparency of IPD might have been absorbed by the company.

TAKEAWAYS

- Project-first or team-first attitudes are unusual in the building industry but common in IPD projects.
- Alignment around project goals was evidenced by scope trading within the team and the team's ability to anticipate and mitigate problems.
- Significant savings for cost and schedule—both dramatic and small—resulted.
- Teams developed tools based on their understanding of the owners' goals and how those goals would impact the actions of the team as a whole or as individuals.

Context				Legal Commercial			Leadership & Management				Processes & Lean					Alignment & Goals			Building Outcomes				
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Team Culture

All of the sections in the Team Culture category address themes we and other researchers have covered in past work about the importance of team culture and how it can be measured as an outcome of and a contributor to overall project success. For this study, we chose to build upon that work and focus more specifically on how the teams interacted with the owners and translated the owners' goals into action. We understand collaborative team culture as an outcome marked by good communication, effective decision-making, and mutual trust and respect. The most successful teams report a high level of interaction and feelings of positivity, believing that the project is a career highlight or that it has led to enduring friendships, for example. All the projects in the study have very positive team outcomes, ranking as high as any of the top-performing projects we have studied. Those with the most positive team perception of their team's culture and effectiveness tend to also have invested the most in planning and communication, particularly in Lean processes and tools. This correlation may be due to the increased awareness and intentional goal setting around team effectiveness, or it may be that the activities around Lean planning provided a base for a stronger team culture. Team members believed that a collaborative team culture is a major contributing factor to a project's success. Interestingly, some teams attributed the strength of their culture to factors other than the IPD contract or formal training, typically commenting that the team selection of collaborative personalities was the key. Other teams credited the culture to early discussions around the development of the contract and intensive formal training. Measurements of success were most commonly based in Lean practices, such as reliable promising or other performance measures tracked over time.

All of the owners and most of the teams in this report responded consistently with a larger survey sponsored by IPDA (IPD: Performance, Expectations, and Future Use: A Report On Outcomes of a University of Minnesota Survey, 2015), which found that, overwhelmingly, project teams were very likely or extremely likely to pursue IPD again. The RMI and Autodesk teams offered slightly more mixed responses, with comments that reflected widely varied opinions regarding the use of IPD on relatively small-sized projects. Some team members believed IPD was ideal for rapidly moving small projects, and others maintaining that IPD was cumbersome for any project that was not large in scale. While we can never know what any of these projects would be like without IPD or Lean, the research team noted that the level of collaboration and positive outcomes for these projects consistently compared with the highest-performing projects we have studied in our past work.

TAKEAWAYS

- Strong collaborative team culture was reported in all of the projects in this study, though some teams were more positive than others.
- The most positive results correlated with use of Lean processes and tools, but it is difficult to say if one caused the other or vice versa.
- Different team members came to their understanding of IPD and Lean at different times; allowing for this variation with extended training and mentoring would be beneficial.
- Every team members on all of the projects in this study would enter into an IPD agreement again. The owner's perception of success was remarkably high.
- Successful teams vary in what they identify as the source of their positive culture. Some believe that it's due to the successful selection of collaborative team members; others credit their culture to formal training and structured discussions.
- Fun, humor, and excitement were commonly referenced terms by project team members and owners when describing their experiences on these projects.

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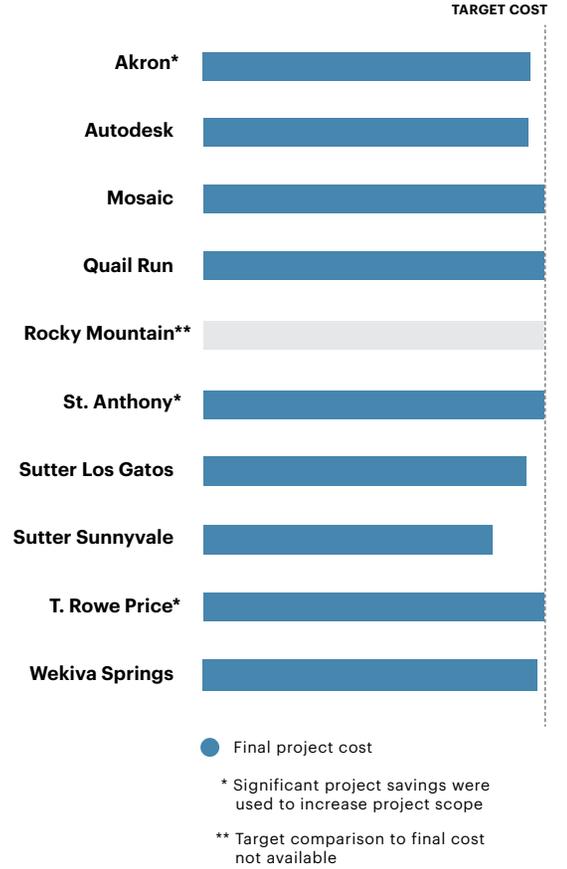
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Profit & Payout

All of the teams in this report had some formal contractual mechanism for sharing the reward pool and uniformly believed that the pool created some degree of incentive for collaborative behavior. Tensions sometimes occurred around the distinction between assigning unexpected costs to either the owner's funds, the project contingency (if there was one), or risk/reward pool. Resolution of this tension usually relied on communication and fiscal transparency. Proportionally, architects typically had a far lower dollar amount at stake than contractors or major trade partners. Architects and others with small stakes, such as specialized consultants or trades, commented that the financial rewards were negligible and their motivation for project success lay in other arenas. However, there were trade partners without a large stake who believed the financial incentive transformed their attitudes and behaviors. The architect for Autodesk is very experienced with IPD and estimates that their typical profits on IPD projects are higher than other delivery types, in a range between 20–25%.

TAKEAWAYS

- Companies had varied financial stakes in the profit pool. Those with smaller stakes believed the financial incentive was not a driving factor for their collaborative behavior; they found other dynamics were responsible for their engagement in the collaborative culture of the team.
- Regardless of the size of stake, there were some companies and individuals that believed their behavior was radically different than in traditional delivery because of the financial stake.
- For at least one architect, IPD projects are more profitable than projects using other delivery methods.



FINAL PROJECT COST
Projects' final project cost related to their target cost.

Context				Legal Commercial			Leadership & Management				Processes & Lean					Alignment & Goals			Building Outcomes				
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Budget & Schedule

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The owners of all the projects in this study believed the teams were successful in managing budgets and schedules and delivered projects with great value. There was variation in project performance relative to budget and schedule goals: some teams were able to deliver faster than expected and/or with lower budget than expected, whereas others met expectations or slipped in one area or another. We reported these findings with an infographic but believe it's important to emphasize that the budget or schedule goal was set differently by each owner or team. Some set aggressive goals below market standards (Akron, St. Anthony, T. Rowe); others used rigorous validation studies to test the feasibility of the project scope and budget (Quail Run, Sutter-Los Gatos, Sutter-Sunnyvale, Wekiva). There were some that had issues arise that were beyond the control of the team (Quail Run). Additionally, some project teams responded that the broad set of diverse goals drove the project and others were primarily focused on budget and schedule (as noted in the Building Outcomes section). Lastly, many project owners used savings or unused contingency to add scope. This was difficult to factor into the project team's performance, relative to project budget, but was a contributing factor in the owner's perception of value. The team's ability to trade scope was seen as a valuable tool in managing the overall budget and schedule of the projects.

We also included in this section information about the project team's management of their time and if they received a profit on the project after the incentive pool was paid out. Results vary, but generally, project team members did not budget sufficient time early in the project but were able to reduce time later in the process. Teams commented that the personnel level, duration and intensity required, particularly in

the early planning, were significant. Notable were comments that discussed the positive nature of these efforts, which saved time later and reduced the amount of energy needed for conflict resolution and other less satisfying aspects of the project.

TAKEAWAYS

- Significant investment of time early in the project saved time later in the project and reduced the amount of energy needed for conflict resolution.
- One contractor has continued to work on IPD projects at a smaller scale and observes that, regardless of size, there is a consistent saving of 24–26%.
- Many owners were able to add programmatic scope by using untouched contingency or budget savings.
- Performance to budget and schedule was generally strong and needed to be considered relative to how accurately or aggressively the original budgets and schedules were set.



MEETING PROJECT SCHEDULE

Projects' construction schedule duration in months, with schedule savings shown in blue and schedule loss in yellow.

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Building Outcomes

All teams in this study reported positive building outcomes, although some will require additional time to fully evaluate technical performance over the course of a climate cycle. For the projects with specific energy goals, measurement of success was quantitative (RMI, Mosaic, Akron); all projects had some form of qualitative goals for user satisfaction. All teams used budget and schedule metrics and reported success in meeting goals. In keeping with the research team's observations that IPD teams are resilient in the face of challenges, we found many stories of significant time and/or cost savings that can be attributed to nontraditional cross-partner collaboration. There were also examples of unforeseen delays or costs that were minimized and absorbed by the project teams within their typical work flow.

The surveys revealed that some projects, like RMI and Mosaic, set building-outcome goals in almost every category—energy, daylight, water, cost, quality, user satisfaction, and other goals set by owner, such as safety or community involvement. Other project teams had much more selective goals, and team members differed in their perceptions about which goals were most motivating. For the teams with fewer goals, cost and schedule were the primary motivating goals, but energy, quality, and user satisfaction were often cited. The surveys and interviews indicate that the RMI and Mosaic teams with multiple goals achieved levels of alignment as high as the other teams. The breadth of responses among individuals in those teams indicates there were differing opinions about which goals had the “greatest motivating effect on the team.”

Within the larger or more complex owner groups, goals and priorities can vary. In these projects, some teams had access to a variety of owner entities, typically tenants/users, Information Technology (IT), facilities, and executives. Teams

learned to resolve differences between owner goals but found it challenging at times.

TAKEAWAYS

- All teams met or exceeded the building-outcome goals.
- Two teams had a broad set of goals of approximately equal importance; others were focused on budget and schedule, with secondary goals.
- The IPD teams exhibited resilience in recovering from cost or schedule impacts through collaboration that broke the silos typically found in traditional delivery.

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
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Project Credits

RESEARCH SPONSORS

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Integrated Project Delivery Alliance (IPDA)

www.ipda.ca

IPDA explores and supports emergent practices demonstrating enhanced industry outcomes and provides a forum for the exchange of knowledge.



Lean Construction Institute (LCI)

www.leanconstruction.org

LCI operates as a catalyst to transform the industry through Lean project delivery using an operating system centered on a common language, fundamental principles, and basic practices.

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Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
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Project Description

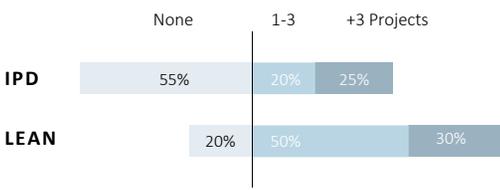
PROJECT	Akron Children's Hospital, Kay Jewelers Pavilion
LOCATION	Akron, OH
BUILDING TYPE	Healthcare
PROJECT TYPE	New Addition
CONTRACT	Custom
OWNER	Akron Children's Hospital
ARCHITECT	HKS & Hasenstab
CONTRACTOR	Boldt & Welty
PROJECT START	November 2013
COMPLETION	May 2015

Project Images



Photo Credits: Akron Children's Hospital

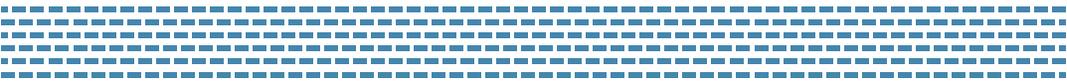
Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 20

Approximately half of the team members were new to IPD, and half had some or extensive IPD experience. A majority had some experience in Lean, with the remaining having either no previous experience or substantial experience. Some of the national team members had worked together on prior projects, as well as the local team members with each other, but overall, the national and local teams did not have prior relationships with each other.

Building Size 365,000 sq. ft.



Budget \$175,047,595



Schedule 24 months design 22 months construction



Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
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Project Description

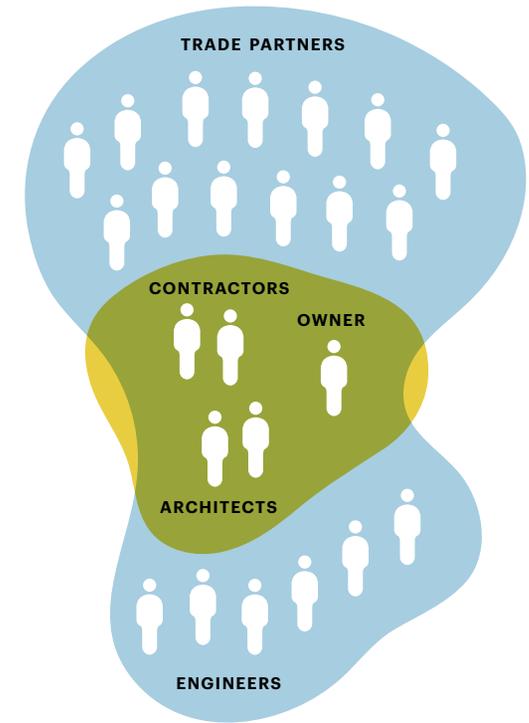
Akron Children’s Hospital, highly experienced in Lean health care processes, had followed traditional design and construction in their buildings. Facing an expansion with a lower budget than in similar facilities, they saw an opportunity to use integrated project delivery (IPD) and Lean principles in design and construction. They also believed they could impact the local business community by introducing expertise in both Lean and IPD. Their goals were twofold: build expertise sufficient for the project and provide resources for the local building industry to become adept at IPD and Lean. To accomplish these goals, they chose an architect, contractor, MEP engineer, and MEP contractor well respected in the local area then paired them with counterparts nationally known for their expertise in Lean and IPD. The owner, Akron Children’s Hospital, committed to cross-company mentoring and formal education for the entire team. Because of their proficiency in Lean, the owner was comfortable measuring, using, and promoting a wide range of Lean tools, and this was supported by the expertise of the national contractor and architect experienced with Lean and IPD. For example, the team-selection process employed site visits to verify use of Lean, and they utilized Choosing by Advantages (CBA) for the final selection. Among the unique aspects of the project were:

- Requiring both the national and local teams to educate about and promote IPD and Lean to the local/regional industry
- Boldt Construction’s CBA decision-making methodology and the dynamic team-selection process
- Owner-controlled full-wrap insurance
- Extensive success metrics and incentive tied to metrics

- Extensive use of Lean tools and processes, including A3, CBA, Plus/Delta, Last Planner System, reliable promising, dashboards, and location-based planning

PREVIOUS RELATIONSHIPS

Boldt was familiar with the national architect, national drywall contractor, and electrical contractor. For the local MEP engineer, their interface with the national teams evolved from the beginning of the project. The national architect had experience with several team members and felt that the prior experience made a difference: IPD “made it more challenging because we had to determine how each other worked in the past and in the present, and then mash our cultures together.” The local contractor had a multiyear relationship with the owner, and had completed over 100 projects on the hospital campus, most of them with the local architect. This brought a comfort level and understanding of the owner and good working relationship with the owner and architect.



● ORIGINAL CONTRACT PARTIES / SIGNATORIES
● RISK / REWARD

AKRON PROJECT TEAM

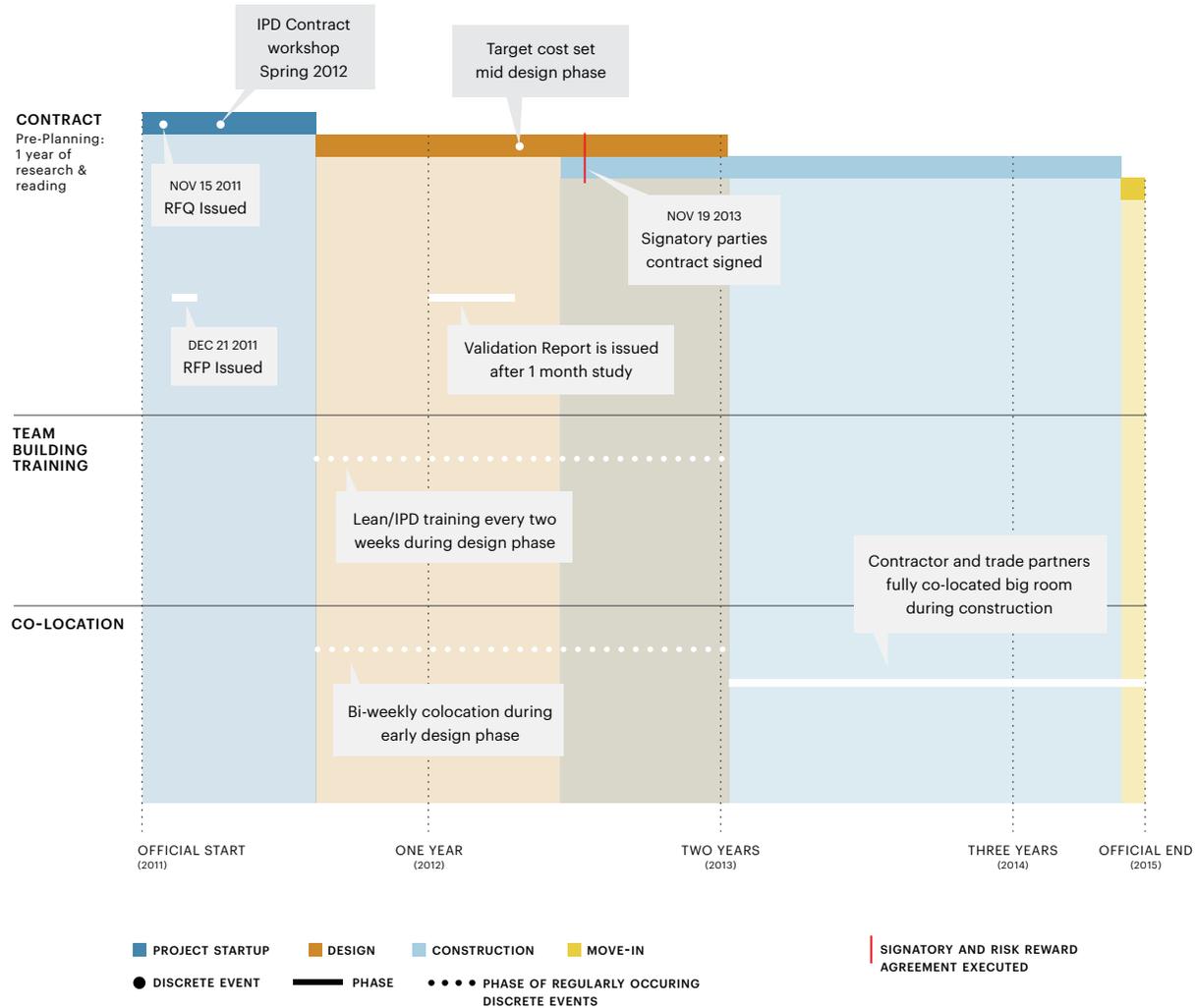
The owner originally wanted the risk/reward pool to include all of the companies involved with the project in order to maximize buy-in. The project leadership team recommended an opt-out choice for any company that did not want to participate in risk/reward. Overall, there was a fairly large proportion of the team included in the pool. The signatory pool included the owner (Akron Children’s Hospital), the local and national architects (Hasenstab, HKS), and the local and national contractors (Welty, Boldt). The risk/reward pool included six engineers and thirteen trade partners.

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AKRON PROJECT TIMELINE

The validation study was done after the contract was fully developed. This sequence is relatively unique, since many IPD projects complete the validation before the contract. In this case, the owner believed the contract discussions created a foundation of trust on which to build the validation. (Note: this is based on the narrative and interview, the fact check shows the validation is well before the contract finalized.)

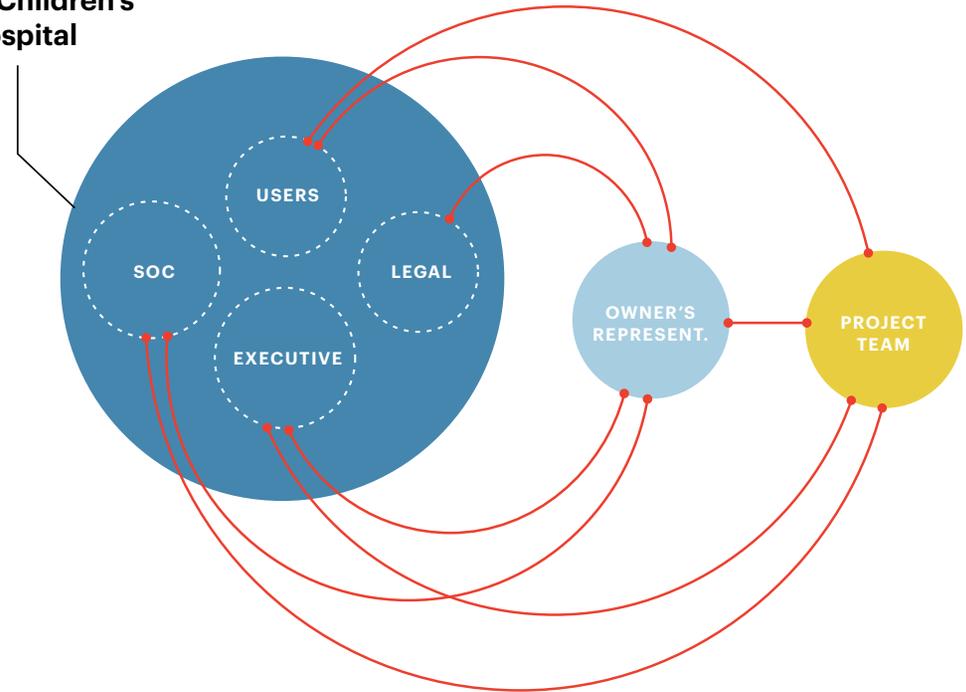
Context				Legal Commercial				Leadership & Management				Processes & Lean					Alignment & Goals			Building Outcomes			
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Owner Identity & Interface

The owner's group consisted of the hospital's COO, the Center of Operations Excellence, an associate general counsel, the vice president of construction and support services, and the director of planning, design, and construction.

The owner was in a stable financial position, and their market share was growing at the time that this project was designed and constructed. They have significant competition from three other children's hospitals in the area, and their patient demographics are flat to slightly declining, particularly in the children population. Their growth is due to the acquisition of other health care groups, which expanded their network and increased their market share. The limits to the business plan meant that they expected little to no ROI for this project. Since they knew there would not be a significant (or any) ROI on the building and because they were not adding space or adding business, their expectations for the project team were to deliver value at the lowest cost possible while meeting their quality metrics.

Akron Children's Hospital



KEY
SOC: Senior Oversight Committee

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Choosing IPD & Lean

Historically, the owner was a very traditional facility owner and construction client. “We had several different processes that we used, whether it was construction management or design-build or CM at Risk [construction manager at risk]. We had several different ways that we did our big projects, but we followed a very traditional process, and we relied very heavily on our vendors, architects, construction managers—less so our users and the people who were going to be using the space.” The owner had been adopting Lean health care processes since about 2008, and the internal Center for Operations Excellence team of eight people had been helping the owner “implement [Lean] in terms of doing A3s, green belts, blue belts, black belts, the whole nine yards, kaizen.” The owner stated, “It’s really changing the culture of the organization to say, ‘Let’s change the processes so that they work for the systems that we have in place.’”

To keep up with market standards, the owner needed private-room neonatal care and expanded emergency-room facilities. They initially talked about integrated facility design and knew their traditional building program would not support their Lean operations. “We needed to bring our Lean teams in and work with our clinical users to determine how we should be practicing in the future. They went through all the value-stream mapping and decided, ‘Let’s redesign that clinical process and build a building that supports that.’ Then we stumbled upon IPD, and we realized that these really make sense to do together because our culture is a collaborative one. We don’t want to do top-down, we want people to collaborate to really deliver value for our project.”

Based on what they understood, the owner believed that IPD and Lean could help them achieve a target cost below market estimates: “We needed to deliver this project at a cost that

we could control and afford.” Even though several members of the board of directors are in the construction business, no one had heard of IPD. Champions on the owners side said, “It took a long time for us continually doing presentations about what IPD was and how it could make a difference [in driving value]....Once they [the board] understood how the process worked and what we were going to try, they were willing to take the risk.” The owner also said, “If we, as an organization, didn’t have some appetite for risk and for innovation, we probably wouldn’t even have tried IPD. We would have just stuck with our traditional methods.”

After visiting several IPD/Lean hospitals, the benefits were clear. The owner said, “Because we already had used Lean for operations in the organization and we had seen the value of continuous improvement to the organization, we just said, ‘We can’t build the way we’ve always built this. Let’s put our money where our mouth is. If we’re going to use this operationally, we should try to figure out what the future state [of health care] should be and build a building that really meets the purpose and product that we’re trying to deliver.’”

- The owner’s experience included Lean health care and traditional project delivery.
- IPD was consistent with owner’s Lean and collaborative culture.

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Team Selection

The owner wanted to influence and grow local expertise in the area of IPD and Lean. To encourage knowledge transfer between firms, which were nationally known for their IPD and Lean experience, and local firms, they paired national and local firms for all the major stakeholder roles: two architects, two contractors, two MEP engineers, two MEP contractors. For the national contractor, “We had double the number of entities on the team, coming together for the first time to work together and also to deliver a new process that most folks were not familiar with. That presented a significant challenge in itself.” The work was generally divided so that the national partner was the lead during preconstruction and the local partner took on the lead role during construction.

Team selection was based primarily on metrics. The owner issued request for qualifications (RFQ) and request for proposals (RFP), and then conducted interviews. Proposals covered organizational charts, experience in IPD and Lean, experience in tri-party agreements, integrated facility design, LEED, building information model (BIM), and local experience. The owner reflected, “We had a very specific objective method for what we requested and then how we evaluated what was returned to us.” After the local and national engineers, architects, and contractors were selected, they joined the owner to form what would be the core decision-making group for the duration of the project, the project leadership team (PLT). The selection process for the subcontractors followed a process developed by the national contractor—a robust method for choosing partners based on Boldt Construction’s trademarked Integrated Lean Project Delivery (ILPD) process and CBA. The contractor recalled, “We had a whole process that was developed around going out and seeing. We developed an RFP based on what we wanted to support [in] our project culture, and then we actually

went out to the job site, out to their facilities, and did a Lean assessment of the trade partners. We did an assessment both on the presentation they did for us, plus a little more weight on the go-and-see approach of what they were actually doing in the field.”

As major trades came onto the project, they signed a joining agreement that tied them to the main contract. According to the owner, this meant that “there was buy-in right at the beginning that they were going to be part of the incentive team.” The local ME engineer expressed, “We were asked to be in the risk pool by the project leadership team. We fully embraced it.” The structural engineer saw trade partner selection as a “full-team decision,” starting with first deciding which trade partners were needed, followed by discussions about the advantages of candidate partners among the teams to come to a decision. Most of the architectural consultants were on board before the validation report, with mostly trade partners with minor scope being added after. According to the local ME engineer, the trade partners that came on after validation were invited to submit proposals with the understanding that all members of the project team would be expected to fully embrace Lean and IPD: “Here’s the contract, here’s what your requirement will be as a trade partner.”

The local contractor was not familiar with the particular terms of project-based insurance and found that the additional paperwork to enroll project participants was unexpected and challenging. “There were many times when we had a last-minute decision to go in a different direction for a specialty contractor. And there were many times when they [the insurance company] just flat out said, ‘No, they haven’t been cleared yet.’ That made it awfully challenging for us.”

EXPERIENCE

One of Boldt’s executives and several of the team members were contributors to Sutter’s first series of IPD projects and became valuable resources for this project team.

The local team relied heavily on the national teams for their experience in Lean and IPD. According to the local architect, “They were truly like the Lean and IPD gurus. They did an awful lot of the education and on-boarding process and culture building.” This was the first IPD and Lean process for the local architect, and they saw that the team had great internal resources, “people who had varying levels of awareness of Lean design, co-location, all those niceties.”

- The owner wanted a team that would benefit from working with experienced IPD and Lean leaders and that would also grow local or regional expertise in both.
- The owner used a process developed by the national contractor that employed CBA analysis and included site visits to fabrication, job sites, or offices.
- Once the architects and contractors were chosen, they had input selecting the remaining team.

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Developing Contract

Contract Type: Custom by Akron Children’s Hospital counsel with elements of ConsensusDocs 300 and AIA 195

The project used a five-way agreement between national and local general contractors, national and local architects, and owner. Joining agreements bound other members of the team. The owner said they paired national and local “because of our interest in securing local folks to work on the project and creating that innovation and knowledge about IPD and Lean within our own community.”

The owner’s general counsel blended aspects of ConsensusDocs 300 and AIA versions of IPD contracts to create a custom contract. The owner, contractors, architects, and their respective lawyers had two intensive sessions to draft the contract: the first for three days and the second for a week. The national contractor said, “The sessions were very effective because, more important than hammering out the terms of the deal, it got everybody on the same page.” The owner understood it took time to understand the contract “because it’s so new, and it’s not anything any of your trade partners have ever seen or any of your people that you’re working with have ever seen. It was just challenging to educate people on what we’re trying to accomplish, what this all means.” According to the national architect, the primary team members “worked it out page by page and agreed to inclusions or exclusions....From that perspective it was very clear and defined. Where things got muddy had to do with when we were on-boarding trade partners or consultants to the prime agreement. There were discussions about a lack of clarity in the contract language about expectations. It got difficult as you went down the layers.” There were trade partner meetings with the national contractor’s legal counsel

to discuss the contract and its terms, but those sessions were less intense than the core team discussions.

The contract earmarked some decisions to be made later by the PLT. The project manager for HKS Architects, said, “It was probably 90% there, but that other 10% was pushed down and written in to the contract that the PLT, the guys in the trenches, would handle these as they came up. That may have been a little of a challenge. It could have probably been better defined.” The local architect and the national contractor agreed that “there was quite a list of things that had to get developed [by the PLT]. It took several months, and that was a challenge.” Items included: the incentive plan, adverse-weather-day tracking and logging, and equitable measurement of schedule.

The local contractor said, “Everyone’s going to have some sort of notion as to how a negotiation is going to transpire. But I think everyone entered into it with an open mind and a willingness to think outside the box.” For the structural engineer, the hardest part of the contract to manage was that the final execution, including the incentives and pay breakdowns after work had already been completed.

The insurance was an integrated project insurance program, paid by the owner. The national contractor had seen similar “full-wrap” policies before, but noted that intense discussions around it made it appear unique to some partners. The owner observed waiving liability was “fine with everyone.” His challenge was working with the insurance industry: “We spent months interviewing insurance companies, just like we interviewed our trade partners. In one interview, the underwriter kept asking, ‘I understand all this IPD stuff, but in the end who gets blamed?’ They missed the whole concept of IPD. There is no blame. We’re in it together, so we’ve got to

come up with a solution.” The local architect said, “Basically everybody was covered under one umbrella, or one policy, period. People had a hard time understanding that. Realigning hourly rates for that became very problematic. We had an issue with roofers because their worker’s comp was based on a projected number of hours, and they went over.” The local contractor said, “It helped the team save \$1.7 million, so it was a good thing overall. There was a lot of extra work that went into it though.” The national architect chose not to participate in the project insurance plan: “Our insurance limits were high enough. Generally, the insurance plan worked fine for the trade partners.” The national contractor signed the waiver, along with most of the parties, to not sue each other. The national contractor commented that he would like to see a project-based analysis of risk since not all IPD projects are run the same way. He observed, “Who you do business with matters.”

- The base contract included local and national architects, local and national contractors, and the owner.
- The owner’s legal counsel led two intensive four-day sessions with stakeholders.
- The other partners reviewed the contract line by line before signing joining agreements.
- The owner’s insurer developed a full-wrap policy that allowed the team to waive liability and cover subcontractor default. A local contractor estimated this saved the team \$1.7M.

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Developing Parties

The owner recalled, “We all sat around and philosophically discussed that [risk] and how risk was going to be shared. Our pricing reflected that additional risk in our success metrics and in our incentive compensation. Because we [the owner] were taking additional risk, the other team players put more of their money at risk.” The owner felt that the documentation related to profit and incentive was clear. In contrast, the architect needed more clarity around finances, including how owner budget decisions would ultimately affect fees. The national contractor learned that “you really need to do some actual simulations of how the incentive program works and how it’s not designed to work, so everybody is on the same page. It was the one aspect of the project that wasn’t clear, and though we all appeared to be speaking the same language, there were different perceptions on how it was to be executed.” They noted that the incentive-pool structure was effective since it used metrics instead of a simple pool to be divided proportionally among participants. The contractor described how the terms set a maximum incentive that could be earned, with percentages tied to metrics including: safety, user-group satisfaction, owner-group satisfaction, and quality. “There was a whole metrics program that fed into the incentive pool. Based on how the team scored, that would determine the percentage of what the sharing was on the savings. I thought that was highly effective.”

The local architect recalled when companies asked to be in the risk/reward pool, the PLT asked, “Is this the right party to build the most effective project?” The PLT took into consideration the culture of the company as well as their cash flow since profit would be held until distributed. Team members with small scope of services or who chose not to be in the risk pool worked for a fixed fee and received traditional roles and responsibilities.

The owner initially wanted all of the companies involved to be a part of the incentive pool. “The PLT decided that some people could opt out of the risk pool. From a realistic standpoint, that was a necessary evil. For instance, we didn’t put our equipment suppliers in the risk pool. They said, ‘We could be in the risk pool, but your clinicians are making decisions on the equipment.’” The national architect believed a large risk/reward pool was beneficial: “It has to do with buy-in. If you don’t buy in to that philosophy and that theory and you have this split in your team, that’s just not good. It’s not healthy for the culture of the project. If you had a project with a high proportion of people not in a profit pool compared to people participating in the profit pool, that would be a problem. Because then you have different standards...you’re operating under a different expectations.”

All of the team members, regardless of incentive pool or other contracts, shared their hourly rates and overhead with an independent auditor. According to the owner, “There was a bit of anxiety from people once they understood what we were asking for and that they had to just lay it all out there.” The national contractor believed the system was very equitable: “Everyone was reimbursed their costs. Some firms may have lower overhead, but they were neither penalized or nor profited from it since they were reimbursed their costs.”

The local architect saw a challenge in the contract’s assumption of a forty-hour workweek, which they felt was misaligned with their work norms: “For the way architects typically work, forty hours is a luxury, not a norm.” The architects observed companies using unionized labor to pay overtime for hours beyond forty hours per week, which was different than salaried employees. The architects concluded, “It’s a little bit of injustice.” The national architect also saw

some challenges arise because of the fundamental differences in business practices between companies. They observed, “Initially, there were a lot of issues trying to create parity between a CM’s fee structure and the architects or designer’s fee structure. We had to work pretty diligently to try and come to a common ground on what is considered overhead, what’s considered profit, what’s considered your base rate.” They have seen this issue come up on all of their IPD projects. “It’s just different from the how we are structured as a business organization compared to how the CM is structured. Our overhead rates are just very different.” The national contractor had a different point of view regarding the differences between companies and their rates. He said, “A small specialty contractor has a much different rate than an architecture/engineering firm; this was understood. There was never any attempt to equalize the rates.”

- The owner originally wanted all of the companies involved with the project to be in the risk/reward pool. In the end, companies were given the choice to opt out.
- The national contractor appreciated that the incentive pool incorporated metrics instead of a simple proportional payout.
- The national contractor believes that simulations of how the incentive program works in practice would have been beneficial.
- Local and national pairing worked efficiently; duplication did not raise overall fees.

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Champions

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The team saw that the hospital, as an organization, embraced the theory of Lean for removing waste and for constant improvement in their daily operations. Applying Lean on the project was in line with that internal culture, and IPD was an extension of those construction practices.

The local architect viewed the owner as the “two-pronged” champion for both IPD and Lean: “They were the motivator.” The architect believed that between their expertise with Lean health care operations and their interest in IPD, the owner “could get the best of both worlds by not only getting everyone to work together and be collaborative but also by integrating the Lean aspect of analyzing the design in how it impacted their operations. They, then, could couple that and take it to the next level with the contractors and the overall process of project.” He also understood that the owner’s culture supported both Lean and IPD: “They’re big about collaboration. They’re big about everyone participating at all levels. I think they felt that all in all, [combining Lean and IPD] was great for the whole process, design, and construction.”

Generally, as the local architect saw it, it takes a committed owner for architects to be able to see the benefits of IPD. Along with the benefits of collaboration, having the resources of team members to vet decisions and having an environment without confrontation was something that “it took some getting used to”: “Particularly our end, there might be a lot more up-front work that might make you feel like you’re spending so much time doing things that you have trouble being able to see the overall results or benefits. But in the end, the pluses probably outweigh the minuses. You have to have an owner that’s committed to that, and those are few and far between. So trying to force that on an owner who’s not committed would not be worth the effort.”

The local architect found the experience of collaborating with trade partners very educational and “very refreshing to me as a leader of younger architects...to have that trade partner right there and learn to make decisions alongside them. That is education that normally time teaches you.” He saw that experienced architects also benefited when they would bring up an issue and hear, “‘Yeah, but we work around that all the time by doing it this way.’ That’s invaluable....We don’t get that in design-bid-build.”

The national team members with IPD experience assisted the local teams. For example, the local contractor “had existing trade partners that helped a lot with the education needed for the new trade partners.” They are confident that this project has provided a strong foundation in IPD, and “the more we use this process, the easier it will be for us.”

The unique nature of this project in the Akron market promoted positive discussion with partners outside the team. According to the local architect, “Early on in the process we reached out and created very healthy relationships with the unions as well as with the building departments to say, ‘Listen, we’re doing this differently. It’s a good spotlight for Akron. You’re learning something that other people aren’t doing. This is going to bring a knowledge set to this community that we don’t have, and a lot of people don’t do this nationally, so we’d like your cooperation.’ They were very helpful and supportive all the way through the process.”

- The owner’s leadership in Lean health care processes developed a culture that supported IPD well. The team members considered the owner to be a champion for both IPD and Lean.
- The national architect and national contractor had extensive experience with IPD and Lean construction and gave the team confidence as well as formal training.
- The architect noted that the involvement of trade partners in the design process created an excellent opportunity to model collaboration for the younger architects in the firm.
- The team felt a sense of responsibility to model IPD and Lean for the local building community; they educated and developed partnerships with the local trade unions and building departments.

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Decision Structure

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The owner's Center for Operations Excellence was involved with the entire scope of the project. The owner made internal shifts so that the vice president of construction and support services was able to focus more of his time on the construction of the project. The director of planning, design, and construction was also involved, and the owner brought in an owner's rep. The associate general counsel worked on the contract and insurance.

A trade partner oversight committee (TPOC) met monthly. According to the national architect, "That really encouraged this notion of collaboration and open communication."

There were three primary groups: the senior executive team (SET), the project leadership team (PLT), and the project implementation teams. The PLT had the most control or influence on the team as a whole. They worked to establish metrics and the definition of success by soliciting input from the SET, and came to a consensus as a PLT on how the measurements could be calculated equitably and ensure that there metrics included activities in both design and construction.

The local architect credits much of the success to the owner. "We asked the people who were involved in the workshop to be ambassadors to their peers and to bring issues back and forth. So there was a series of checks and balances that we used throughout the whole process to make sure that the staff was satisfied, that we had all the issues taken care of. The hospital's culture also supported that. They empower the frontline staff to make the decisions to meet the goals and expectations of the project."

The local architect described, "The owner is one body within the project leadership team. They get one vote to our one

vote, to the contractor's one vote. It has to be unanimous for us to move forward, or else we have to go to another tier of decision-making. That's very unique from any of the projects that we've ever worked with on." The local architect saw the most significant difference of IPD projects as "making the decisions when you have to make them and not in advance. It really changes your mind-set on what you could do. If I had to do a traditional project right now, I could get it done a lot faster because of having been exposed to a lot more options."

The owner saw that the incentive pool had the desired effect of people making group decisions to provide value for the project. The innovation teams would come up with inventive ways to solve problem, put them on an A3 to present to the PLT, and the PLT would decide if it was worth the cost and would add value or if another team should do that bucket of work. Then, whether approved or not by the PLT, the A3 was posted so that everyone knew the information, and the decision was transparent.

- The owner shifted resources internally to ensure that top-level executives had time to support the project.
- A trade partner oversight group met monthly and was considered to be very effective to promote communication and collaboration.
- The three primary decision groups worked well: one at the executive level, one at the project-leadership level, and one at the implementation level. The owner had an equal vote in the PLT, which was the group with the most influence on the project.
- The owner's culture empowered frontline hospital staff to make decisions, and their input was very effective.

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On Board & Off Board

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The national contractor and national architect partnered with one of the owner's Lean experts to hold Lean boot camps for everybody, including the owner and the owner's staff. Each new team member engaged in two days of training. The owner spent about \$367,000 on Lean training for the team, and they considered it important for developing Lean expertise within the team. The owner recalled, "It was an eye-opener, and it was also a little bit controversial. I remember sitting next to a plumbing supervisor who said, 'I have no idea why I'm sitting here playing with Mr. Potato Head toys. When I'm on a job, I get to work.' I hunted down that same plumber at the Christmas party, and he said, 'I was very skeptical, but this is going to make me much more competitive.'" A variation of the on-boarding boot camp was used for the construction phase, geared toward the construction team members engaged in that phase of the project. By offering the workshop multiple times, the national contractor believes they were able to introduce all trade partners to Lean "as on-boarding and education, and then, obviously, we reinforced that through daily actions."

The team used the motto "You better get comfortable with being uncomfortable" to describe the need for adopting new ways of working. The local contractor expanded, "You really need to be able to forget most of what you've done in the past and open your mind up to the possibilities of the future and to different ways of thinking or looking at challenges. Some firms have that kind of cultural flexibility, and some just don't."

Any member of the team could be discharged if they were not performing since the financial model was based on cost reimbursements. The local architect described how a decision to terminate a member of the team was collaborative: "It never was a decision of any one party. It always came to

'These are the measures we've taken. Here are some potential countermeasures.' After you exhaust those, it's time to cut our losses and move on." The national architect generally saw that "most of the time there was very clear evidence that made it simple to off-load that entity." The national contractor said, "The one thing that the team did very, very well was to recognize poor performance and then make the decision quickly as to whether or not that member's performance could actually be improved or whether a change had to be made."

Two teams left during the project. One left the project to avoid "opening their books"; the other had performance issues identified by the national contractor: "They didn't engage." The owner recalled that the nonperforming partner was "functioning under traditional methods, and they weren't collaborative and they weren't delivering the kind of product that we wanted." The national architect also saw that their "numbers weren't really clear and whole." Coaching and meetings with company leaders led to a promise of change. The owner then re-interviewed them to confirm qualifications. However, once the company was reintegrated into the project team, they went back to their old ways. "It's a credit to the team and to the IPD process that we were able to remove this organization without any—at least I didn't sense—impact to the project." There was another instance of the team having to coach another group that was not working well collaboratively, but they turned around, and according to the owner, "ended up being decent members of the team." The team removed the sheet-metal contractor several weeks before they started installing ductwork for the project. For the national contractor, "The fabricator, during preconstruction, performed very well, but then they weren't following through in their ability to fabricate the way that you needed them to.

Most companies would have said that [replacing them] was a disastrous move, but it actually turned out to be a huge benefit for the project."

Others had a different perspective of the off-boarding. According to the local MEP engineer, "That part of the process [off-boarding] was not very open and transparent, honestly. Most of us, even some of us who worked with [the sheet-metal contractor] very closely—they were a trade partner in part for the product that I designed—we just showed up one day, and they weren't there anymore. I'm sure that decision wasn't made in an afternoon. There wasn't much in the way of why; it was just, here we are, let's move forward. It was a surprise."

- Everyone on the project participated in extensive on-boarding with an intensive Lean boot camp.
- Cultural flexibility was described as "You better get comfortable being uncomfortable."
- Off-boarding was a clear process, and the team was quick to identify subpar performance.
- Some companies left the project; others were coached and became productive team members.

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Clarity of Goals

The national architect said, “The goals were clear. I think, primarily, the success of that had to do with the owner’s intimate engagement in the process from the start to the end. The project goals and their guiding principles were very clear from the onset and were a testament to their involvement in the whole process. It became a natural course of the project to achieve those goals.”

The national contractor said that the owner “viewed this project as a fulcrum that they could use to leverage accelerated transformation of the departments that would move into the new building”: “It was not just building a facility but about helping to transform the company’s culture and their own internal process and practices about how they would deliver health care once the building opened, which presented its own set of unique challenges. How do you develop, and design, and construct a facility when, at the same time, individuals are rethinking how they actually deliver care?”

Every week, the goals were printed and posted on the walls of the Big Room. The local contractor referred to them as “public knowledge,” communicated “all the way down to the field level.” Goals were frequently discussed, particularly schedule, cost, and safety. From the perspective of the owner, “Everything that we could measure they heard about every time we were together.” The guiding principles were also up on the wall in the Big Room, and the team referenced them often.

The local contractor highlighted the importance of tangible goals. “First, we got the foreman and project managers and superintendents together, and we laid out the challenge. Once they had wrapped their head around it, at one of our weekly all-project huddles that includes 400, 500 people, all the

workers on the site, we said, ‘If you’re a part of the team that’s working in this area, this is what we’re working for, and here’s how we’re going to get there.’” To make a goal tangible, he said, “We’d break it down and relate the goal or challenge to the individual, make it something that he can see contributing to and helping us make a success.”

The local MEP engineer ran into issues with understanding the owner’s goals. They said, “The owner’s goals weren’t 100% clear to us from a mechanical/electrical standpoint on day one.” They further explained, “Someone from the outside sees Akron’s Children’s Hospital as the owner, and their goal is very clear. They wanted this type of programming, for this type of budget, and they have these design goals, [which are seen] through the eyes of a child. A number of those visioning goals the hospital organization felt very strongly about. Now, when that comes ten levels down, to the world that we live in, where we talk about types of piping materials or redundancy in equipment, those goals were not very clear. There was a decent amount of time spent trying to get the owner’s decision on any number of those things.”

The structural engineer worked to understand the owner’s goals for floor vibration and developed designs—one steel, one concrete—for the owner and team. “I felt we were very aligned on that with them after going through case studies of each possible system. And then using cost analysis, we were able to determine that the concrete building was the best fit for the project budget and the owner’s requirement.” The owner and local contractor, with a contrasting opinion, identified the vibration control and slab deflection as a major issue that was not coordinated well, resulting in remedial work to level the floor. The local contractor believed that the team

fell short by failing to resolve the issue early enough to avoid remediation on all the floor slabs.

The owner and the PLT set quality metrics related to cost, time, quality, safety, LEED and energy, and staff and patient satisfaction. The local architect said, “It wasn’t just achievable metrics. It’s stretch metrics.” He also emphasized the need to communicate: “We want everybody to be aware of those early on in the process, if that [understanding is] not developed until we’re far into the process, it hurts the performance and the effectiveness of the team.”

- The owner wanted to promote IPD and Lean in the local/regional building community.
- The national contractor saw that the project advanced the owner’s goals around health care delivery.
- Updated goals were “public knowledge,” which the local architect called “stretch metrics.”
- Actionable goals were explained in weekly all-project huddles, which included 400–500 site workers.
- The designers did not believe the goals and metrics were clear enough for their purposes.
- The owner’s floor-vibration parameters were met, but remediation was required for floor-slab deflection.

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Resources & Facilitation

The hospital planned to hire an outside Lean consultant, but after they selected HKS and Boldt, they realized that the team had excellent internal support for training. The local architect said, “We ended up creating our own design process and Lean operation, which the hospital’s Lean Six Sigma organization was very helpful in setting up.” While that appeared to be effective, as they moved into later phases, the team realized they needed additional education. The national contractor said, “We understood that in some ways we were speaking a foreign language and that we were going to have to raise the capabilities of the team members to be able to use the processes that we were developing. So education was a big focus for the team.” He went on to say, “Akron Children’s understood that there was a need to invest in education, so we didn’t have to fight to convince them that it would be necessary in order for them to gain the value that they were after.”

The national contractor had experience with personality profiling and understood its importance for the team. After a team discussion, the five core companies agreed to use profiling and engaged a facilitator to work through issues. The local contractor recommended a consultant, and based on the recommendation of the national contractor, the core team chose to use human brain dominance indicator (HBDI), which focuses on communication. In the words of the national contractor, “The one thing that happens on every projects is having to deal with relationships issues. We equate our IPD projects more to marriages than anything else because we don’t have any other option but to resolve our differences. The construction industry is seeped in tradition, and the roles of the architect and the contractor, no matter how hard we try to get away from those at times, sometimes revert back to past practices. People perceive actions on the project

differently, and sometimes we need help from a third party to help smooth out those differences or help us see what’s really happening. That rears its head quite frequently on IPD projects. The roles of leadership change on these projects—in the programming phase, the owner might be on the lead, and then during the design phase, the architect and engineers are on the lead, and then during construction, you got the contractor on the lead. Those transition periods are when we experience hurt feelings and different attitudes, and we generally have to have some help in getting through that.”

The local architect saw that the trades in the field were motivated by doing work for children, which the project would benefit from, but that they could be better motivated through orientation to the project goals and process shared by the project team. “You’ve have fifty guys in the predesign and construction period to process. You want to get the message to the 350 guys who have more impact on the outcome of the process than anybody else. We went through a high level of orientation and safety training—the day-to-day operations—but we never really told them why they were doing what they were doing. We needed a better educational process just on the overview of what we’re building. It puts more pride in the work. I also think having a better educational process on the success metrics and the terms of the contract would be beneficial too.”

The national architect saw a greater opportunity for active lessons learned throughout the process on Akron Children’s than on past IPD projects, which had more distinct starts and stops for design and documentation. The entire team went through a full two-day lessons learned, sponsored by the owner, and documented outcomes. In addition, the team performed retrospectives at strategic points throughout the

project for the team to review the work that had just been completed and to discuss how it might be done differently in the future. In this manner, the team embraced a continuous learning culture.

There were workshops on target value design, CBA, built-in quality, production planning, and control training that ran multiple times during the job. Most were workshops with simulations and hands-on learning, which were geared toward having fun. The team tracked what education people participated in. The local architect thought the education sessions were good, but that some were overkill: “It could have been cut into a day or two and would have been probably a little bit more effective.” The PLT formed a book club open to all members.

- Early Lean planning was done with resources internal to the team and owner group. Later, the group believed they needed additional education so outside resources were brought in by the owner.
- Multiple training sessions on Lean and IPD allowed all team members to benefit.
- Human brain dominance indicator training was used to better support the typical transition periods when leadership within the team shifts.
- Workshops on Lean process and tools were run multiple times throughout the project.

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Tools & Processes

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During construction, the team updated the visuals and metrics for leading indicators weekly and produced a monthly comprehensive report. The SET used these to track the status of cost, schedule, performance, safety, and any issues. The frequency of the project management team's daily huddle was tracked; the number completed by target dates was a success metric.

The owner emphasized safety, "We don't want anyone hurt on the job, especially one for a hospital." Out of the 100 possible total points for all success metrics, safety was the most heavily weighted. For the local contractor, "Quality was huge. The metrics basically wanted a team approach to resolve project issues quickly and effectively through collaboration."

Surveys were used to measure the satisfaction of hospital staff and patient families, and the entire IPD team, monthly, did a survey that fed into a pulse report based on a template used by the national contractor. These surveys became a part of the success-metrics documentation. A third-party firm developed the IPD team surveys—five to eight questions on collaboration, how the team was functioning, and current team issues. Graphic and written results included a word cloud generated by team members describing their feelings about the project. The national contractor said, "It's really an important aspect of the project. You typically can't see the changes or feel the changes on a project month after month because you're so close to them. But when you see those snapshots of the words, it really helps you draw out where the team is really at." The local contractor saw that the team surveys measured confidence in meeting targets. He said, "If people don't believe something is going to happen, it's not going to happen. There's always a certain level of healthy doubt, but people still need to believe that if they try their

hardest, they can get the challenge done." While valuable, the pulse report covered the previous thirty days, so it was a trailing indicator, and the team believed it would have been helpful to have predictive indicators. The team also measured how well they did answering questions, which helped them validate mutual respect and reliably meet commitments.

The team measured percent plan complete (PPC) weekly, tracked with graphs. The national contractor believed that 100% was an appropriate goal and indicated a highly reliable team. The local contractor had a different understanding that "if a contractor continuously got 100% plan complete, that was bad. That meant that they weren't challenging themselves enough; 80%, 85% plan complete meant that they were challenging themselves." During the daily huddles, teams would make commitments and move stickies onto the floor plans based on where they were going to be and what they would be doing that day. The floor plans were posted on boards on each floor. The national contractor used visual management for location-based planning and storyboards, on which trades could mark off their progress.

The local MEP engineer felt that they had a lot more involvement during construction than they normally would because of "first-run studies," a process used by Boldt and introduced to this project. The team performing work mapped out the exact process for the work. Crew size and duration were estimated. A sample portion of the work was performed while measuring all the aspects to be compared against the estimate. If the actual performance exceeded the estimate, the team would revise the sequence and run another study until the team met or beat the budget. If/when the budget goal was met, the budget would be adjusted and savings added to the incentive pool. Boldt also introduced the "game

tape" process, which video documented an action often repeated on-site, such as a concrete pour, to analyze and identify wasted effort. After wasteful actions were identified, adjustments were made for the iteration. Efficiency was thus increased using the approach of plan-do-check-act.

The team used CBA throughout the project, but primarily for on-boarding trade partners or when they had difficulty reaching consensus. The local MEP engineer said, "We, as a team, struggled to use the CBA tool effectively. Every time we tried to use it, it took a large amount of time, and I don't think we did it frequently enough for people to really get it or use it well." The team found the regular use of A3s and Plus/Delta to be more effective than CBA. The local MEP engineer felt, "We didn't really get good at pull planning or with the A3 until toward the end of the process."

From the owner's perspective, it was understood that the architects wanted to make the design process Lean, using physical models and mock-ups to communicate design intent, which were translated into drawings once a decision was made.

- The team used daily huddles, weekly metrics, and comprehensive monthly reports.
- There was a 100-point metrics scale; safety was most heavily weighted.
- The monthly surveys measured project team satisfaction and responses to the Lean workshops.
- Visual documentation, such as models, was an important communication tool for the designers; visual controls were extensively used on-site.

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Lean Effectiveness

The team used the concept of last responsible moment (LRM) almost daily. According to the national architect, “As the last responsible moment came on [certain] items, if there was money available to add into the project, we would. If the last responsible moment passed, and we weren’t able to make a decision on [a particular item], then it was no longer valid.” The local architect saw that set-based design was new to a lot of people and “that challenged the team a little bit, too, understanding that we make our decisions at the last responsible moment so we can keep the project moving forward and not getting it out of the way just because it’s convenient for any one party.” The local MEP engineer commented that using LRM and understanding that others were relying on you to meet your promises had an effect on his behavior. He recalled, “You came to realize how much your work affected other folks. If it was the last responsible moment to make a decision because it would affect someone else, you were really held to that. That required you to think of things sooner than what you wanted to, but in the end it was better for the project. It made things flow better from a team perspective.”

When they ran a Plus/Delta, most of the team found it refreshing to be able to talk openly about things that were not working. The national contractor said, “One of the things the team ultimately said was that we didn’t do retrospectives frequently enough.” The national architect saw that “the team did a fabulous job analyzing after every workshop, every workweek, what went well and what needed improvement. They did a Plus/Delta, ad nauseam, after every meeting. But then the teams implemented the changes and improvements.” The local MEP contractor said, “Every meeting had a Plus/Delta. Frankly, I don’t think that was used very well. Other than the fact that it helped state something

out loud to the group. What was good versus what was bad. I never noticed any deliberate use of Plus/Delta for team improvement. Maybe it just happened because you heard what other people were saying.”

- The team regularly used Plus/Delta and A3 but found CBA cumbersome.
- Reliable promising and last responsible moment were powerful tools for this team.

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BIM

In spite of a collaboratively developed a BIM project-execution plan, the team had interoperability issues, which led to some overlapping and redundant work. There were also issues surrounding expectations about the level of development and about model progression. The owner was pleased with the effectiveness of clash detection and CAD-CAM for ducts and pipes but was, overall, frustrated with how the team handled BIM: “Everybody failed miserably. It should have been one model with everybody’s input, with major pieces of equipment with a make, manufacturer, and model number associated with them.” By contrast, the local architect thought the owner “didn’t have the resources within his team to be able to use it [BIM]....So there was a bit of a disconnect. The owner’s expectations weren’t clearly defined and that created some problems for the team.”

From the team’s perspective, multiple models and interoperability issues are common in the building industry since fabrication models are specific to one trade or another. They acknowledged that consolidating data from the multiple models resulted in additional cost to the owner. The local architect believed the issue of multiple models was less about interoperability and more about the delay of fabrication modeling: “The point that we considered 95% was when the trades started to do their model. We had a design model and we had construction model, and because of the platform issues we always carried two models. We’re probably always going to [have two models] until the technology allows fabrication to occur out of the model. Steel uses one platform; ductwork uses another platform. There are going to be some challenges with that, but the issue was that we had the design model but it had to be 95% before the trades felt that they could get started.”

The local architect believed that there was potential value in the team’s major investment developing a report analyzing BIM abilities within the team. However, the timing of the report was too late to be useful. After the experience with BIM on the Akron Children’s project, he recommends that all BIM designers be co-located.

The national architect was not completely satisfied with the use of BIM on the project but thought it was still used effectively on certain parts of the project. “All in all, I would say it was used effectively. It was the right way to do the project, and it benefited us tremendously. As with everything, there were challenges, and we had a few challenges.”

They saw the most difficulty in coordinating with the MEP production model that tied to computer numerical controls, noting points of confusion regarding which models governed the fabrication process.

The national contractor agreed that there were lessons learned on the project: one was the importance of tracking who was drawing what and when; the second was the need for more attention to be paid to the design-to-construction handoff. Overall, they thought the use of BIM was very efficient and well implemented. The MEP team, in particular, depended on BIM. They saw that one of the issues that came up with coordination on a connecting bridge was due to the sprinkler system not being modeled, and generally believe that it is good to get as much detail as possible into BIM to stay out of trouble in the field.

For the local MEP engineer, this was their first experience producing BIM with the intent of incorporating installation drawings with production. From their perspective, the owner’s needs for the model as a facilities-management tool were not clear in the beginning, “so we ended up having to

go backward and doing some work that we [had decided we] didn’t want to do the first time.” The engineer went on to observe that a significant plus to using BIM on an IPD project was that “everyone involved in the project was in the room from the beginning. You don’t have the situation of designing and assuming what someone else needs to price and install, because those people are in the room with you. Their input is affecting your design, and you’re affecting their install.” They said that even though all of the contractors were responsible for making installation drawings, in some instances trades would do drawings for other trades if they saw there were synergies and there would be an overall savings to the project.

To help everyone become familiar with where they would be moving into, the team created a virtual tour through the space so that those who weren’t engaged in the workshop with the staff could feel like they were walking through the space.

- BIM was used effectively for clash detection, but the team struggled with multiple models that needed coordination and had interoperability issues.
- Co-locating the BIM designers would have been helpful.

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Workplace

A Big Room near the hospital was established at the onset of the project, along with a warehouse for mock-ups. The national architect noted logistical issues coordinating work between the Big Room and warehouse locations since events were held at the same time. He said, “Usually in concert with Big Room activities, we would have workshops in the warehouse, where the full-size mock-ups would be done. In hindsight, we probably should have tried to locate those people and those entities together so that we were all working together.” Toward the end of the working week, the Big Room group and the warehouse group would come together to reflect and wrap up as a group. When the team reached the detailed-design phase, the work in the warehouse ended.

The owner took the approach of documenting the team-building components of IPD rather than individual responsibilities: “That was the real demarcation from the old AIA or traditional contracts. We didn’t necessarily worry about who was responsible for what, because in IPD the team decides who is best to do this piece of the work, who was best to do that. We focused more on what we needed to do to create a strong team—it was requiring a BIM platform, it was requiring Big Room collaboration so that people didn’t have the option of saying, ‘I’m going to put my own trailer on the site and work there because that’s what I’m used to.’ You have to work in the Big Room.” The national architect created a Revit server that everyone could access, rather than having a server in the Big Room, which they saw as too large an expense for the owner. There was a dedicated Revit station in the Big Room for accessing the Revit model.

During the planning phase, the teams gathered two weeks out of each month in the Big Room. During construction, the contractors and trade partners were fully co-located, and

architects and engineers remained in their own space. The national contractor believed that the separation created silos that could have been improved if the designers had been co-located during construction. Additionally, the team had an area they called Mission Control, where records of decisions were kept, and it became the place for the team to congregate every day for production-planning work.

For the local MEP engineer, “One of the both frustrating and satisfying parts of that was that there were periods of time when everyone was in the Big Room, and nothing was really going on. That was frustrating because you have work you need to be doing, and there wasn’t anything scheduled. That also happened to be when some of the more innovative things happened.” He said for those team members whose offices were close by, “it was easy to excuse yourselves [to go] back to your lives,” but presence in the room was important: “The way that it operated, you really needed to be in the Big Room to be included. A lot of the good that came out of it was spontaneous.”

The team committed to weekly huddles by phone that last about fifteen minutes and included about twenty people. For the local MEP engineer, “It sounds like an impossibility, but I thought that it was very effective. Having to call in once a week and spend thirty seconds answering whether or not you were on track with what you were supposed to be doing helped me keep myself on track and not fall behind on certain tasks. To actually stick to a fifteen-minute conference call is something that I wouldn’t have said was possible prior to this.”

- The team had two shared work spaces: one Big Room and one warehouse for mock-ups. While both were effective, the team believes locating them closer to each other would have been beneficial.
- The team developed a variety of effective frequencies and durations of meetings tuned to the project phase, which ranged from weeklong co-locations to regular fifteen-minute calls.

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ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
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Team Alignment

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After the contract was signed, the team spent three months in subgroups, including innovation teams that formed around different building systems and a team developing the operational design for the program. Together the subgroups developed a validation report and set project targets. There was a radically different perception on the value and effective timing of the validation study. The owner dismissed its importance, believing that it was done too early without sufficient information: "It didn't result in anything that anybody had any confidence in. We did it because the contract required it. But we essentially scrapped it.... We were so early in the process that we were still trying to figure out what we were building and how we were going to build it. So we just created this document that we call the validation study." In contrast, the national contractor would have preferred the study even earlier in the process. In their experience, it "actually becomes a bible to give everybody the guidance of what the initial intent was for designing.... It becomes the controlling document on the project and a critical piece of information to ensure that the design, the budget, and the schedule all remain in sync." Even though his perception was different from the rest of the team, the owner believed that their sequence led to a better result than if they had done the validation first, as is common in many IPD projects: "All those pieces and parts of the contract really made people much more comfortable in collaborating, making group decisions." He believes without that comfort level during validation, "I'm not sure we could have gotten a price that was that low."

The national architect regarded the validation study as an essential and key to the PLT's belief "that we could hit the ultimate target for the project." The local contractor agreed that the study was a reference point for PLT: "We

had cash-flow estimates, program, benchmark costing, staff communications, staff needs, contingency analysis. We even validated the integrated Lean project-delivery statements. National versus local costing indices, production strategies, what we're looking for in BIM." For the national contractor, validation answered the question "Can we deliver a facility that will allow the owner to deliver the care in the building, with the amount of money they have available, and within the time frame identified in their business case?" He believes validation eliminates "the rework associated with a team producing a design or a building that doesn't align with those expectations."

The project-based insurance helped protect the team from finger-pointing behavior. The national contractor recounted, "There was much less 'Why did the mistake happen, or who made the mistake?' than 'How do we fix it, and how do we make sure it doesn't happen again?'" The structural engineer said the insurance gave him the freedom to collaborate: in a typical project, "if somebody messes up, everybody still has that potential of going after each other. If everybody's under the same policy, everybody understands what it says and everybody knows what everybody's skin in the game is. It is one of those things that's always in the back of your mind. To not [have that on your mind], like on this project, lets you move easier."

The national architect held the view that a contract cannot legislate behavior: "The primary signers and originators of the contract understood it, but I think with a traditional contract we would have had the same behavior had we agreed on the parameters of how we were going to work together. I don't think signing the IPD contract created the behaviors that we operated with." The national contractor concurred, "I think

that most of the project team members may never even have read the contract. We did things to explain what the commercial model is, what the production-planning system is, what target value design is, but not with references back to the contract."

Both the national contractor and national architect thought the contract served an important role to reduce risks for the contractor and allow the owner to recognize what their costs and issues were. The architect said, "The contractor didn't have any ulterior motives to make money up on a certain part of the job. Their motivation was to give the owner what they wanted. Everything was basically done at cost. Plus at the end, your success metrics gives you your profit." The national contractor reflected about IPD contracts in general: "The risk associated with a project is the same whether it is delivered conventionally or with an IPD arrangement. What is different is that risk is managed either proactively or reactively."

For the local MEP engineer, a significant difference of the IPD project was "the way that the project was structured, maybe contractually, that we all succeeded or failed together. The failure of one teammate affected the others the same. That really changed the attitudes and the perspectives of people

- The team believed the validation study aligned them and was a touchstone.
- The owner and the team had different opinions regarding the timing and value of the validation.
- Project-based insurance, release of liability, and early contract execution gave the team confidence for deep collaboration early.

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Collaboration

The team maximized efficiency by ensuring the right people were involved with decisions. The MEP engineer described the end of each weekly planning meeting, when several categories of outstanding issues would always be posted on the whiteboard with clearly marked questions: “Who’s the champion? Who are the stakeholders that need to be present for it?” He noted that the public posting made it easy for anyone to be included, even if they were not an obvious stakeholder.

The team had the freedom to trade scope and finances around the project. At some point in the project, everyone’s profit was fixed. As they took scope from one and gave it to another, no one was penalized by having their profit reduced. The national architect said, “Everything was measured by a TVD [target value design] process, and all the innovation teams had goals and had stretch goals. But there was always the understanding that if you could save more to benefit a different innovation team, then great.” The local contractor saw the question of shifting scope and profit as challenging, since the calculation of cost benefit was complicated.

There were several examples of ways the team distributed expertise, work, or equipment to benefit the project. One example of shifting scope resulted from a study done by the team to figure out the most effective way to do the surveying on the project. The team ultimately determined that the concrete contractor had the appropriate expertise, and that company did the general construction layout with their full-time layout worker. Another example was when all of the MEP layouts were combined under the mechanical contractor because they had the capability and the equipment. There was a shared-equipment program for the equipment that every contractor typically uses on a job.

Early on in the project, there was a major scope change to delete the ambulatory clinics. For the national architect, “The beauty of it was that we had all the processes set from the beginning on how we would react to changes in scope, how we would react to conflict. We went through those, the conflicts, etcetera, and other things, but since the process was already set, we just worked the process, and it didn’t affect the schedule at all. That was very different from a traditional project.” This success was mentioned by several team members as an example of how they absorbed changes without a negative effect on the project.

However, team members also shared a story where things did not go smoothly. The owner had clear criteria around floor deflection and vibration control. The local contractor offered the owner a choice between steel and concrete, which would affect both deflection and vibration, and this became an early issue when communication was poor and the team reverted to blaming behavior: “If we would’ve sat down and looked at it as a team, we probably would have been able to minimize the impact. Instead, there was some defensiveness. I don’t know the true cause—maybe it was in the way that we brought about the issue—but it was like a month and a half before we got to the productive problem solving.” Another team member recalled, “By the time we were done blaming and moved onto problem solving, we had cost ourselves money.” The team learned from this event, and when a massive fiber-optic-duct bank was discovered that could have delayed the project six months, they were able to handle it well. Although there was initial discomfort in discussing why it had not been detected earlier, the team members uniformly believe that they skipped over the blame phase and “moved right into ‘All right, let’s brainstorm some ideas.’”

The owner saw nontraditional collaborations occur on the project, such as between the glazing contractor and the electrician. “We’ve had these colored light strips built into the mullions of the glazing system. And the electrician sat down with the window manufacturer and the suppliers and determined how best to make that happen. Versus the old way that it would have been designed—put the window up and then the electrician figures out how to attach these colored light strips.”

- The team was effective in developing a list of issues with champions assigned to resolve each one.
- The freedom to trade scope and budget was supported by a shared incentive to maximize profit for the team.
- There were many examples of shared expertise or equipment that saved time and/or money.
- The decision processes set up at the beginning of the project allowed the team to work through conflicts with no negative impact to the budget or schedule.
- The team learned from an early conflict, and subsequent issues were handled far more efficiently and collaboratively.

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WEKIVA SPRINGS CENTER EXPANSION

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Team Culture

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The owner considered social activities to be “really important to how that team got along and why innovation really happened.” The team met every Wednesday at a local bar before activities such as pierogi making, airplane rides, and games. “We found out who was really competitive and who was not. It was really a good way for people to get to know each other.” The local architect described one inside joke: “We were sitting with a bunch of [building] users, and they thought we kept saying ‘corn shell’ when we said ‘core and shell.’ They were calling it ‘corn shells’ so we call that team the Corn Shell Team now, and we have tacos together every week.”

The local architect compared this project to those using traditional delivery: “We had a lot more fun, solving issues, honestly. Stuff was less confrontational in general. Everyone would swarm an issue, and we’d solved it.” Others on the team concurred, and the local contractor said when an issue was discovered “our team got together right away, and rather than saying, ‘I can’t believe you did this, you’re such an idiot,’ we immediately set to solving the problem as quickly as possible, as cost-efficiently as possible. Most teams don’t get there until days or weeks after the issue has happened.”

The local contractor commented, “We were all set in our ways. It was such a new process, everybody was hesitant. But once we started, it just took off. Everybody was engaged instantly; it just made our job fun. It got rid of that same old, boring set-in-our-way type of atmosphere that we were so used to. I’ve been living it for three years now, and it’s still exciting. I’m still learning it and enjoying it.” The national contractor gave the example of team alignment: “We had a big rainstorm, and the concrete [pour] wasn’t going to happen that day because we had a lot of cleanup to do. Everyone pretty much stopped. Everyone pitched in, put a hand to cleaning the mess up, and

by the next day, we were back into production. In a traditional project, we would have probably been fighting over who’s going to do what, and the cost of work and downtime for different contractors. We were able to just get back up and running like nothing happened in a few hours.”

The team celebrated successes. The local contractor commented hitting targets “was a reason to celebrate, and we did that very openly and as a team.” The team developed what they called their Bambino Program, which was a recognition program for continuous-improvement ideas around safety, quality, people, schedule, and costs that were primarily identified by field personnel. They posted the small wins or implemented improvement ideas both in the field and in the office, to share the learning across the team. The team formed a Baker for Builders Club and asked the end users who toured through the site to bake something to give to the workers during the tour. For the local architect, the site tours for the end users were gratifying: “It was cool because people said, ‘This [building] is what I imagined in the workshop.’”

In retrospect, the local architect saw that the project influenced their practice: “It just became how we would work on a day-to-day basis as the Children’s team, and we’d morph it through to other aspects of our office as well. So it’s been a very positive experience.” The national architect had previous IPD experience but found Akron uniquely “organized to the nth degree.”

Several team members commented on how IPD allowed the team to focus on what was best for the project. For the local contractor’s superintendent, “The biggest thing to me about working in IPD is there is no atmosphere for blame. Blaming people really doesn’t add any value in an IPD contract because at the end of the day, it’s all of our problem to deal with. In

traditional construction, we spend so much time and energy trying to figure out who screwed up what. If we just spent that same amount of time and energy that we spend blaming on moving things forward, fixing processes, preventing issues in the first place, you could really see transformative results.” The contractor saw that the team skipped the blaming to collectively solve the problem and get things on track, and later talk about lessons learned. The local contractor relayed that they would “do [IPD] again in a heartbeat because it was an amazing learning process, and obviously the benefits speak for themselves.”

The owner relayed, “Everyone remarked that after the project is done, they missed the project. The team liked working together. This was a rare kind of experience. They’re usually saying, ‘Thank god I never have to see this person again.’ There’s a high degree of camaraderie and trust in this team.” The owner is using IPD again on smaller projects with only the local firms and stated, “It became more streamlined because most everybody had been educated.”

- The team socialized, had opportunities for team building, and celebrated their successes.
- The local architect considered the team more fun and less confrontational than traditional ones.
- The local contractor noted that after the team got over the initial hesitation of the new delivery, “it just took off.”
- The team members said IPD allowed them to focus energy advancing the work instead of wasting it on blaming or defending.

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Profit & Payout

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The national contractor said, “The national players primarily took the lead in the preconstruction effort, with the local players playing a support role. And when we flipped during construction, the local players took the lead role in actual execution, and the national players took a supportive role. Through that whole process, we were able to put a fee structure together that wouldn’t have been a whole lot different than if one player had taken the whole project by themselves, so it wasn’t really a duplication of fees. They probably paid a little bit more with that method because there would have been a little duplication, but not significantly more. It wasn’t double. The benefit that was received by the project—clear in the results—shows that this was the successful way to go.”

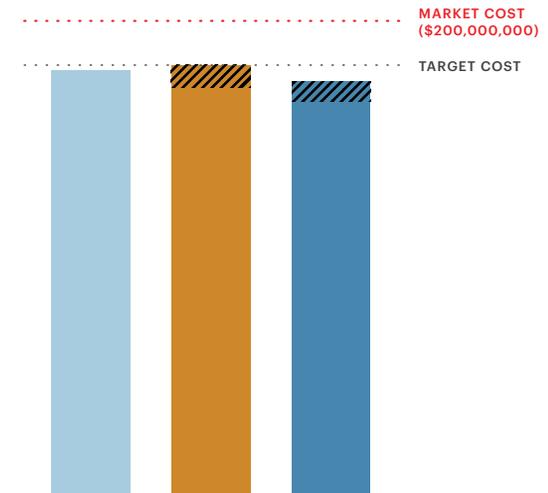
The overhead was paid out every month, the profit was paid out at milestones based on project performance, and the incentive was paid out at the end of the project. At the end of the project, a representative from the owner, contractor, and architect groups worked to evaluate the metrics that had been met. After an independent auditor certified the metrics, they released the incentive dollars. The incentive related to the post-occupancy survey was released at a later time. The structural engineer said that approximately 60% of their profit was tied to reaching the target value, and the other 40% of profit came when the costs were below target.

The local contractor described that at the beginning of the project, the budget gap was huge, and there wasn’t confidence that the team could close that gap. Once the team started to see cost savings as a result of their decisions, confidence grew. At the start of construction, the team had successfully reduced the cost but still needed to reduce an additional \$20M. According to the local contractor, the largest

cost savings occurred early, with subsequent progress in small increments: “It was a conversation around the stamina. Hoping and feeling confident, but still cautiously optimistic that they were going to continue to look for ways to save money, even if it was going to be \$20,000 here, \$15,000 there, \$75,000 there.” They also said, “With the production side, it’s a little bit more difficult [to realize cost savings] than on the design side. With design, if you make a change you can reflect the cost immediately. With production, if you say, ‘We’re going to prefabricate exterior walls.’ We know that that should save X amount of dollars, but the cost doesn’t come out of the project until we actually go and do it. It was a healthy level of fear or risk that drove us to make sure it was as good as we said. As it ended up, that extra effort made us not only close the gap, but drive way below.”

The national architect said, “As a project, we were on budget. Obviously, through the ebb and flow of the project there were spikes and valleys within our projections and our actuals. But in the end, we beat all of our projections.”

- Overhead was paid monthly, profit on a milestone schedule, and incentives at the end.
- The metrics were evaluated by representatives from the owner, architect, contractor groups and certified by an outside auditor.
- Post-occupancy metrics were evaluated over a period of time.



Allowable Cost	\$180,000,000 (98.76%)
Target Cost	\$182,225,256 (100%)
Final Cost	\$175,047,595 (96.06%)
Target Profit	\$9,707,517 (5.3% of Target Cost)
Final Profit	\$8,270,918 (4.72% of Final Cost)

AKRON PROJECT COSTS AND PROFIT

The final project cost, just under \$176M, was approximately \$9M less than the target cost, but the most striking success for the team was they achieved this budget while including over \$8M of additional scope for the owner, a significant value added. The original expected profit was \$8.2M, and after scope and target adjustments, it was increased to \$9.7M. Profit-plus-incentive fund brought the total payout to \$14.6M.

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Budget & Schedule

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In addition to completing ahead of schedule, the team managed the budget so well that the owner was able to add over \$8M value-add items (which typically would be considered change orders) and still come in under the target value. Change orders for owner-added scope changes totaled \$4.47M. The structural engineer noted, “I feel we’ve met the owner’s objectives as a team. Probably the team left out opportunities because the project was built as quickly as it was. It might have been better to have had more time to vet some things.”

Continuing with IPD on smaller projects for the same owner, the local contractor reported that the percentage savings on all of their IPD projects is consistent: “It’s anywhere from 24% to 26% regardless of the size.” The slight differences in percentages seem to be due to the learning period for new partners who have not previously worked on IPD projects to shift from a traditional mind-set. The contractor has a goal for future projects to only use trade partners who have previous experience with IPD.

The local contractor was approached by the client with the request to have a section of the building done three months early for an important Christmas-tree-lighting ceremony. “We didn’t even know how we were going to do it, but we knew we had the team backing us up to accomplish this goal for our client. Right away the collaboration took off, different contractors saying, ‘Well, I can do this and this,’ or ‘If you do that, than I can do this.’ We got it done, and it was a team effort. On other projects, I don’t know if we would’ve been able to do that. But an IPD concept with this collaboration made it happen. That was a huge success for the entire team.”

The national contractor saw that some of the work typically done during construction was pushed forward into

preconstruction and resulted in savings later: “Preconstruction effort on a conventional hospital project might run you 3% to 4% for salaried labor. We’re seeing it run typically 5% to 7% on an IPD project, and then with the trade partner involvement it becomes much higher. There’s more investment in the up-front planning and design during [preconstruction], which is going to substantially reduce your back-end cost of construction.” The structural engineer concurred, “From a standard delivery process, the most significant difference is really the construction RFI [request for information]. The contractor reviewing our drawings prior to them going out to bid, or for fabrication, really did eliminate structural RFIs and field issues. From a construction administration perspective, traditionally we would’ve budgeted more time than what we spent on this.” Both the local MEP engineer and structural engineer found that they spent more time in preconstruction than typical, but construction went substantially faster. The local MEP engineer said, “We were able to do it with less people and a little more evenly.”

The local contractor said that they encouraged trade partners to let them know as quickly as possible if there was a bust with their projected budget for staffing so they got support. “The reality is that we set target costs for each individual discipline—mechanical contractor, electrician, sprinkler fitter each had a target cost he was trying to hit. The reality is not all 100% of our participatory trade partners hit their numbers. We expected that.”

The local architect said that, overall, their staff budget evened out, and they observed that one of the challenges of IPD and Lean is the amount of unexpected administrative time, “especially with this type of contract where everybody, everything gets audited.” He went on to say, “If you don’t have

an owner that understands the contract and what they’re getting in to, it could be very disastrous.” For the national architect, the issue was less about the amount of time compared to the personnel distribution: “Oftentimes, our staff will be on multiple projects at one time. In an IPD method you probably have fewer staff, but they need to be fully dedicated to the one project.”

The local contractor also identified additional time required to participate in IPD overall. “The nice thing about a traditional project is that you’ve got your number. When you turn over the building, you’ve got your final change order, and it’s done. You know exactly what the financial picture looks like. You don’t have to worry about running it through success metrics. There are a lot of different things that the IPD contract does to create that positive environment, but it [also] requires the team to do a lot of additional work. We’ve been trying to find ways to simplify it.”

- The local contractor reports consistent savings of 24–26% using IPD, regardless of the size of project.
- The team delivered the project fifty days ahead of the twenty-four-month schedule.
- The team gained confidence as they made progress toward the target cost and ended up driving costs below target.
- Compared to typical delivery, team members spent more time on preconstruction planning but reduced time during construction.
- Administrative time required to support IPD, Lean, and fiscal reporting was challenging.

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Building Outcomes

Operational outcomes were outstanding, and the owner reported, “We had a 6.94% operating margin last year when we brought this building on, and we thought we’d have 3% operating margin. So we did really well...exceeding the expectation.”

Since they had a metric for innovation and design with their concrete trade partner, the structural engineer was able to bring in new ideas, such as higher-strength rebar, high-strength concrete, and full-height columns, which were spliced in the slabs to reduce overall cost. The local MEP engineer noted that the locating of hangers before the concrete pour, using GPS, so it would be ready for fit outs was hugely successful. The energy goals were to be in the top 10% nationally, based on the national average of typical BTUs per square foot for a health care facility.

The local contractor said there were almost no punch-list items because they were constantly addressing issues immediately. “When the building turned over, the only issues we really truly had were a couple of warrantee issues.”

PROGRAM/TENANT SATISFACTION

The owner originally hired a consultant to run a yearlong series of workshops with Akron’s health care providers but realized that the contractor, Boldt, and architect, HKS, had the expertise to take on the responsibility. According to the national contractor, “We had a very specific way in which we moved through programming and conceptual design that was unique and different, especially in its breadth and magnitude, than any project that any of us has been involved with.”

The owner saw how the providers and the staff gained confidence using value-stream maps; he recalled a doctor

saying, “You know what? We can do this. I get what you’re doing here now.” Boldt and HKS did calculations and confirmed them with the providers. The owner initially had to push the staff to participate, “but once they started learning, the microphone got taken away from the architect, and the nurses were running around talking about things. It really started the ball rolling.” The owner said that they saw the architect function more as a facilitator and the users as the designers during programming. He relayed how the architects appreciated their role change from receiving feedback on their drawings to being the expert who says, “I’m here to make sure you know that this is required for these standards.” The owner remembered, “We ran into a situation in Emergency Department where we couldn’t make a decision—we did speed-dating design, and three architects were drawing and different people were moving at tables until we came up with [the solution].” The local architect said that they first presented a program that reflected traditional health care delivery norms and then challenged the hospital staff to use it to question what they needed versus what they wanted. “Our jobs as designers became to facilitate. We knew what you had to do by code, and by guidelines, and the regulatory authorities on the project, but we kept challenging them [to figure out their needs]....They were getting frustrated with us, but we just went and put price tag on everything.” He observed the pricing helped people understand the costs, and “everybody involved with the project become responsible for the budget.”

The national architect remarked that different design scenarios for each department “could be led by an engineer, by an interior designer, by an architect, by one of the client users. It was perfect, it was totally flat, it was nonhierarchical, but it was also [independent] of your building trade or your

design trade. It was a true collaboration. The idea was getting at the best flow, the best design for operations and for the patient and staff experience.”

The local architect said that during the design process they met weekly with the users who would be moving into the space, and then during construction they met monthly to give updates and to see if any issues had come up. The national architect still speaks to the owner on a bimonthly basis and said, “The owner was immensely satisfied with the product that was delivered and how they went about doing it.”

The local contractor had confidence that the site-safety goals were met because everyone was diligent about reporting every “finger cut or splinter.” He went on to say the staff, parent, and patient satisfaction goal was almost met: “Everyone knew what the end goal was. We ended up at 94%. We didn’t get 100%, but we were north of 90%, and everybody was really thrilled with that.”

- The owner reports a 6.94% operating margin, more than double the goal of 3%.
- Local contractor noted good coordination resulted in virtually no punch-list items.
- Extensive input from the building users helped separated needs from wants.
- Safety goals of were completely met.
- Staff, parent, and patient satisfaction goals were 94% met.

AKRON CHILDREN’S HOSPITAL, KAY JEWELERS PAVILION

AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE

MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Project Credits

PROJECT TEAM

Signatory Pool

Akron Children's Hospital, Owner

The Boldt Company, Contractor

Welty Building Company, Contractor

HKS Architects, Architect and Interior Designer

Hasenstab Architects, Associate Architect

+ Risk/Reward Pool

Bandwen Williams Kindbom, Engineer

CCRD, Engineer

Environmental Design Group (EDG), Engineer

Thorson • Baker + Associates, Engineer

Dynamix Engineering, Engineer

Parsons Technology, Engineer

Baker Concrete Construction, Trade Partner

Foti Contracting, Trade Partner

KHS&S, Trade Partner

ACP, Trade Partner

F.C. Dadson, Trade Partner

United Metals & Glass, Trade Partner

Yerman & Young Painting, Trade Partner

Messina Floor Covering, Trade Partner

MMC Contractors, Trade Partner

Cahill Mechanical Contractors, Trade Partner

Grunau Company, Trade Partner

Parsons Electric, Trade Partner

J.W. Didado Electric, Trade Partner

INTERVIEWEES

Owner

Lin Gentile (Vice President of Construction and Support Services), Cliff Greive (Director of Planning Design and Construction), Sherry Valentine (Center of Operations Excellence), Grace Wakulchik (Chief Operating Officer), Tim Ziga (Associate General Counsel)

Local Architect (Hasenstab Architects)

Dan Gardinski (Construction Administration), Bob Medziuch (Project Executive), Marge Zezulewicz (Project Manager)

National Architect (HKS- Architect of Record)

John Bienko (Project Manager), Jeff Stouffer (Principal in Charge)

Local Contractor (Welty Building Company)

Paul Becks (Field Project Manager), Tom Conti (Lead Superintendent), Patrick Oaks (Project Executive)

National Contractor (Boldt Company)

Trent Jezwinski (PLT Representative), Dave Kievet (SET Representative), Will Lichtig (IOPD Process Development Director), Nick Loughrin (TVD Manager)

Mechanical and Electrical Engineer (Bandwen, Williams and Kindbom)

Tom Bandwin (Electrical Engineer), Kevin Kindbom (Mechanical Engineer)

Structural Engineer (Thorson Baker and Associates)

Cole Hamey (Senior Project Manager)

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WEKIVA SPRINGS CENTER EXPANSION

Project Description

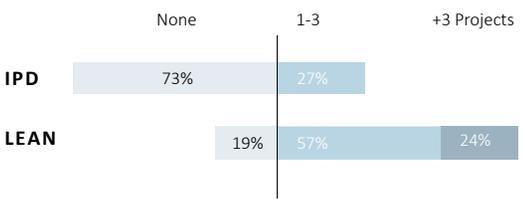
PROJECT	Autodesk Building Innovation Learning and Design Space
LOCATION	Boston, MA
BUILDING TYPE	Office
PROJECT TYPE	Tenant Improvement
CONTRACT	Custom
OWNER	Autodesk
ARCHITECT	SGA
CONTRACTOR	Consigli Construction
PROJECT START	October 2014
COMPLETION	August 2016

Project Images



Photo Credits: Autodesk

Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 22

Most of the team was new to IPD, and several team members had experience with one to three previous IPD projects. A majority of the team had some experience with Lean, and the rest were split between no experience and high experience. Though the companies had worked together on some or many previous projects, most of the team members were new to working with each other and with the owner.

Building Size 35,325 sq. ft.



Budget \$8,700,000



Schedule 8 months design 11 months construction



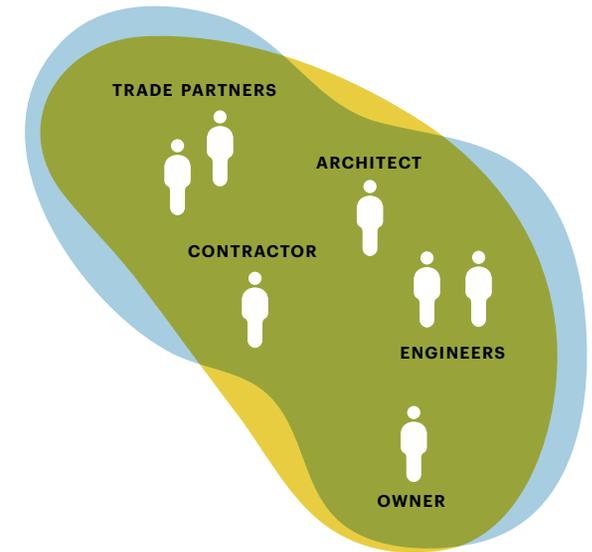
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Project Description

Autodesk was interested in moving from Waltham, Massachusetts, to Boston to be closer to a “vibrant space where the action happens” and to accommodate a new BUILD program intended to lead innovation in architecture, engineering, and construction (AEC) industry. Innovation and design were goals that translated into key performance indicators (KPI) and drove team behavior. The team believed co-location was critical to their success and noticed great gains when the co-location space was fully functioning. The complex nature of Autodesk as a client/owner had both positive and negative aspects, as internal decision-making inspired the team in some ways but created challenges in others. The size of the signatory pool similarly had benefits and drawbacks. It gave voice to trade partners and consultants often not typically included, but the size of the group slowed down decision-making until the team was able to achieve a balanced and efficient process. The project occupies the first, second, and sixth floors of a building in the Seaport district of Boston, formerly used as army storage, that was under renovation by a developer. The project was phased: the first phase was office space on the sixth floor; the second phase, the BUILD space on the first and second floor.

PREVIOUS RELATIONSHIPS WITHIN PROJECT TEAM

The companies involved had relationships with each other, but few individuals had worked with any of the partner companies. Prior relationships was not a deciding factor in team selection. Several of the subcontractors were also under contract with the building developer; this relationship helped with communication. Consigli’s project manager had recently completed a substantial project with the architecture firm but with different individuals. That recent project was very successful and involved intensive collaboration and co-location.



- ORIGINAL CONTRACT PARTIES / SIGNATORIES
- RISK / REWARD

AUTODESK PROJECT TEAM

The owner had experience with multiparty agreements, but the size of the risk/reward pool was larger than past projects. The signatory pool included the owner (Autodesk), the architect (SGA), contractor (Consigli), two engineers (WSP, BIC), and two trade partners (State Electric, T.G. Gallagher).

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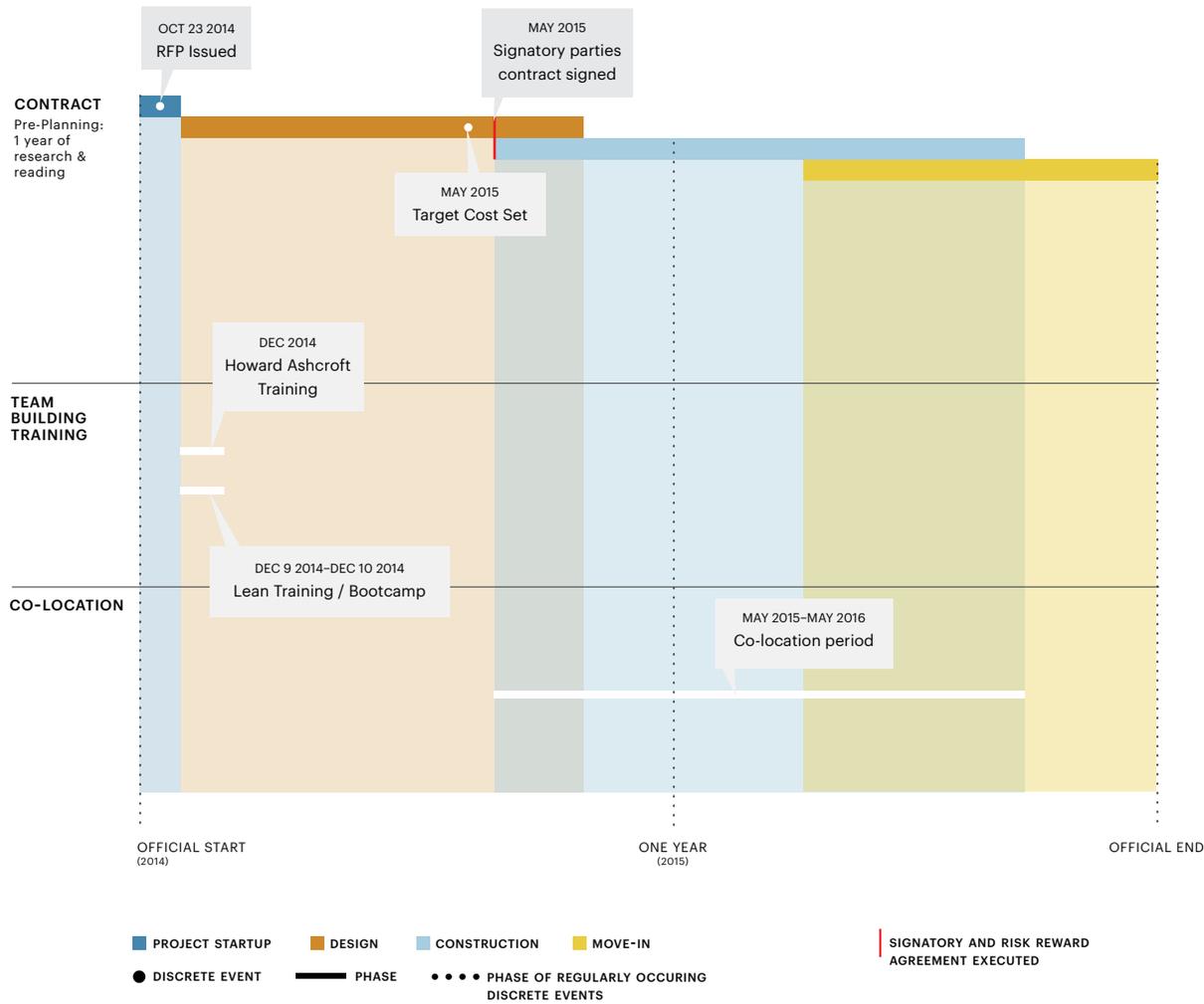
T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

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Project Timeline

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AUTODESK PROJECT TIMELINE

The project team achieved the schedule goals in spite of several early setbacks determining the program needs for the office space. The team found ways to save time by detailing systems that could be easily adapted to on-site variation in floor slabs and by prefabricating conference room modules.

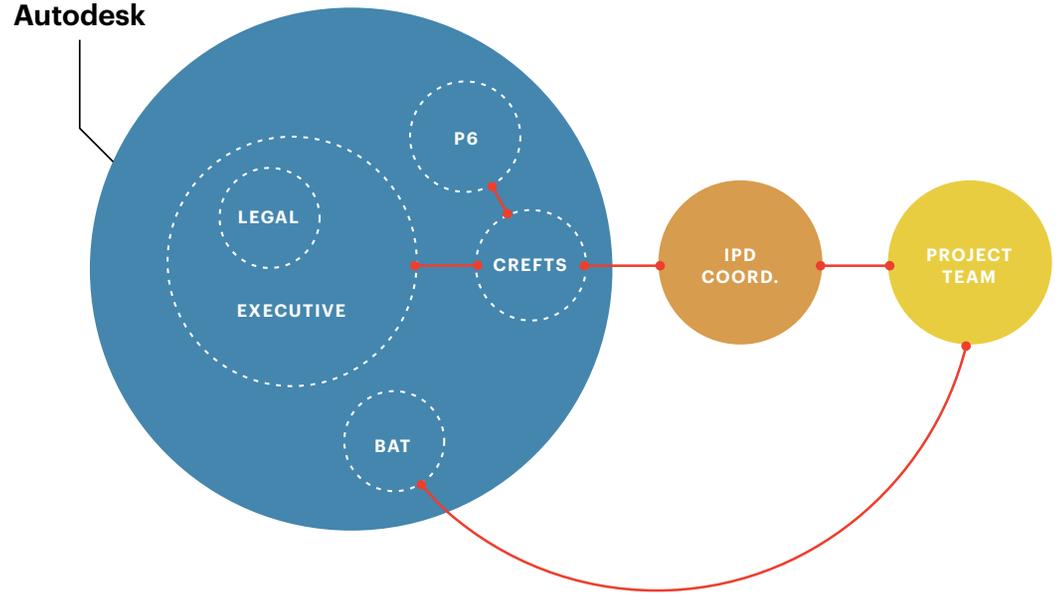
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Owner Identity & Interface

This report focuses on the first phase of the project, the Boston office space, but the programming for the BUILD Space was ongoing during the design and construction of this phase. Autodesk's project manager from CREFTS, Autodesk's internal real estate division, was the point of contact for the team and was familiar with IPD. Due to a number of timing issues, early program design started before the lease negotiations were final. In keeping with common industry practice, only a small number of senior managers were involved in site selection during lease negotiations. As a result, during early program development, the design team had input only from senior management. During the design process, it became clear that the lack of end-user-informed program and remote decision-making was hampering the team's progress. In response, Autodesk formed two internal teams that greatly improved the flow of information: BAT, involved a cross section of end users to assist with defining and testing the program needs; P6, involved six experts from within the company and authorized program- and design-direction approval. P6 interfaced with Autodesk's project manager, the design team PMT, and the general contracting PMT, giving the project manager and the PMT the authority they needed to engage the remainder of the team effectively while also ensuring that those who knew Autodesk's business goals and IPD were guiding the enterprise-level goals.

Autodesk



- KEY
- CREFTS:** Corporate Real Estate Facilities, Travel, Safety, and Security
 - BAT:** Building Advisory Team
 - P6:** Six executives convened for design guidance

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Choosing IPD & Lean

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Autodesk's commitment to integrated project delivery (IPD) has been consistent since their projects in San Francisco and Waltham, and continued with this new project in Boston. All three have been tenant-improvement projects. Autodesk's project manager acknowledged that the project type does not match expectations for use of IPD: "A lot of the reason why we did what we're doing in Boston was because of the success we had in Waltham. It was a good experience. We had a really passionate contractor and architect, who were fully on board. We made great decisions together." The senior architect supports the idea of IPD for tenant improvement: "It's shorter in duration. It's a lower budget. The time available to make effective decisions is about one-third of the [MacLeamy] curve in interior design projects." He believes "IPD is beneficial at many levels of project complexity."

The architects uniformly believe that their experiences on IPD-lite projects, working collaboratively but without a formal IPD contract, had value: "You don't need an IPD contract to act accordingly. You just need really intelligent, thoughtful, client-centric team members who are willing to engage as a team and deliver as a team." While noting collaborative behavior can occur outside of IPD, they also acknowledge the significant resilience and protection IPD provides when things don't go well. As a senior architect speculated, "If this were a typical project, we would likely be suing each other. I guarantee it. There were a lot of misses. In that sense, the IPD contract has been very helpful because people have had a 'We're all in this together' attitude throughout the project." He contrasted this positive experience with a concurrent project: "I had a phone call yesterday about another project where that was not the case. There was a clear mistake made on a project, and everybody was just gunning for everybody else. There have been plenty of times during this [Autodesk] project where, if

it had a non-IPD contractual arrangement, there would have been some mistrust. Probably finger pointing." SGA's interior designer agreed: "When there were changes here, the team absorbed the change and quickly figured out solutions. That really helped us keep our schedule and our budget." The Autodesk project manager acknowledged that the team overcame challenges and attributes their resilience in part to IPD: "IPD can handle ripples in the system. But some of these plunges that we took were hard."

Generally, SGA's senior architect believes that collaboration allows the team "to focus everybody's attention on the real deliverable—to make a client happy." He continued, "when you get everybody in the room, and there is a level of trust that is established early on in the process, you can remind yourself it is about execution, success, programming—what would establish success for that project. It's easy to get people to focus on that. Once they focus on that, they forget about all the other noise in the system. Teams can actually start to do better than they thought they could do. Now all of a sudden, you're not delivering projects on time and on budget with high design, you're delivering very high design, earlier and cheaper."

Trade partners reflecting on the IPD process were generally pleased. One of them said, "It brings everybody to the table, and we're all working together, and everybody gets a piece of it. It's been a great experience so far. Overall, having a group of people work together very closely is a good process."

- Autodesk has been an industry leader in the adoption of integrated project delivery (IPD).
- The small scale and quick turnaround of an interior design project is ideally suited for IPD.
- In spite of the many challenges, the project was largely successful.
- Because of project challenges, the senior architect believes that if it were not an IPD project, "we'd all be suing each other," but in this case there is a sense of "we are all in it together."

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Team Selection

Autodesk issued a request for information (RFI) to nineteen architects, with a request for names of their potential partners. Some declined due to workload. The list was narrowed to six architects, who were given a request for proposal (RFP). The RFP placed emphasis on Autodesk as a leader in the AEC industry. Since many Autodesk customers are in the AEC space, the selection process had to be transparent but free of any conflict of interest. Teams were asked to document past experience with and propose a plan for achieving collaboration, compliance, Lean, building information modeling (BIM), and LEED. Autodesk's project manager recalled, "We came up with a grading matrix that documented how we decided to grade and what criteria measured people by. It was a pretty extensive process, and it's pretty well documented too."

The architect was asked to take the lead on assembling the team. The senior architect recalls that after they selected Consigli Construction and the engineers WSP | Parsons Brinckerhoff Engineering Services to join them as a core group, "the three of us conferred as to who else should be IPD members on a project based on a basic, general understanding of what the goals of the project were, not a specific program." Consigli's project manager believes if architects are included in the choice of trade partners there is a "visibility to the process and feedback, you have to develop the trust early on with the project teams to make this [cycle of trust] happen. Then you get a recursive effect: I trust you [architect]; you have a really good opinion about this [new trade partner] and what we [as a contractor team] are promising. And it builds from there. So, transparency happens—not just fiscally but business-logically and socially."

- Autodesk issued a request for information to nineteen architecture firms, asking them to name their partners. Six teams were invited to submit responses to a request for proposal.
- A grading matrix was developed and used to make the final selection.

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Developing Contract

Contract Type: Custom by Hanson Bridgett based on their standard IPD agreement

The RFP specified a poly-party agreement and outlined several issues regarding insurance and liability release. Jones Lang LaSalle (JLL), a real estate strategy and services company, took a role in coordinating the RFP and called the terms and conditions “guardrails” put in place so that all companies would be relatively aligned at the start. The JLL project manager recalls a relatively seamless process: “We had very minimal comments in our RFP, and there weren’t any real hurdles with getting people to align with the contract, to be honest. Everybody was very interested in doing something exciting because in our region you don’t get too many IPD projects specifically for interiors. Everybody was very gung-ho about being involved. A lot of people—although there might have been some minor comments [about the contract]—aligned their business to go with the flow of the rest of the project.” The lawyer’s IPD expert worked with Autodesk’s internal legal counsel and supported the project management team (PMT). Based on verbal confirmation of selection, team members invested their own time to develop the contract.

SGA’s virtual-design lead described the discussions during the development of the IPD agreement: “I think everybody gets into each other’s business a little deeper, and I think that often uncovers new opportunities about how we can make this process better and to have those discussions when we discuss the markup for this or that.” The senior architect agrees that the process sets up a way of working that is beneficial: “The negotiation was probably a lot longer than it would have been with a different group of people, one that had done this before. [With experienced participants] we would have probably gotten through it in no time flat. But the

process of going through the negotiating contract with each other was helpful to put everybody in a frame of mind to be able to deliver the project the way that everybody wanted it to be delivered. For a few team members that was really critical because they had never done this before, and they—to be perfectly frank—didn’t really know what we were talking about.”

Consigli’s project manager believed that “contractually, agreeing on the target cost was probably the biggest thing. The team, outside of Autodesk, generally agreed on what the target cost should be.” The team “then went down 10% from there as a stretch to try and make what Autodesk wanted.” Autodesk’s project manager helped manage the process of setting the target cost: CREFTS [commercial real estate within Autodesk] is my group. They have in mind what they have set to spend based what they’ve done in the past. But they put the target cost back on the team once the team was selected.” At the time the team was selected, target costs had not yet been set. The team researched the owner’s business objectives and the building program and made a recommendation to CREFTS on the target cost. According to the project manager, the team’s proposal “aligned pretty closely” to what CREFTS had anticipated. He recalls that “there was a little bit of negotiating. But, ultimately, the team came back and said, ‘Here’s what we think a project like this in size and scope costs.’ That figure was put into the contract as a target.”

- The RFP specified that the companies would enter a poly-party agreement and use their own time to finalize the contract.
- Negotiation around the target cost was the most time consuming, and it also took time for some members of the team new to IPD to fully understand the terms.

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Developing Parties

Eleven signatory members formed the group, providing a diversity of voices but also requiring coordination to work with so many companies. On the large number of signatories, Autodesk project manager commented, “I think it has been a little bit of a challenge that we have this many signatories on a contract.” In his previous IPD experience the number of parties was smaller: “In my personal opinion, I like the three-party agreements. They’re a little bit simpler, and the decision-making has a little more snap to it.” He notes that the different levels of IPD experience among the team members was also a challenge: “Bringing in people who don’t fully understand IPD involves an education piece that slows things down too. Hindsight is 20/20. If I were to begin again, I would probably spend a little bit more time with the team educating them on process.”

The large size of the signatory pool made decision-making more complex and slower according to JLL’s project manager: “We have seven signatories to our poly-party agreement. So our PMT technically has seven members. We’ve gone as far as including our equipment consultant in the poly-party. One of the biggest challenges is being able to maneuver quickly enough in the decision-making processes to get the feedback and information we need from all the members and then getting everybody aligned. The poly-party, although it is advantageous for some of those secondary and tertiary poly-party members, sometimes can be a bit copious to run through.”

The team discussed including the structural engineer in the signatory pool, but because they had a small role in the project, they were not included. In retrospect, the team would have included the furniture manufacturer that built the conference-room modules, but the design team did not arrive

at that solution until well after the signatory pool was set and thought that inclusion at that point would not be effective. The senior architect said, “I know we got what we wanted, but not having them as engaged, not having them in the room toward the end, made a little more work for everybody.”

The architects would liked to have seen the building owner included in the signatory pool in order to raise the level of importance of this project within the larger scope of the whole development. This was particularly an issue for HVAC and power, since the building’s services were insufficient for the program, and extensive coordination was needed to resolve the issues.

- Autodesk’s project manager believes the size of signatory pool was too large to manage effectively. He found it difficult to educate all the partners to the level necessary to fully engage them in the IPD process.
- The digital fabrication equipment consultant was brought into the signatory pool later than other team members; most of the team believed that earlier timing would have been very valuable.

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Champions

Within Autodesk, there is significant executive-level championing of IPD and strong support for using IPD for this high-profile space. A member of the P6 advisory group described how this space is particularly important for highlighting innovation in the industry and why IPD is consistent doing that: "This space is generally a platform for many experimental ideas that we have about the building industry. I insisted that the project be an IPD project and my colleagues, the guys who have higher rank than I do, agreed." Another P6 member concurred, "P6 members believe their group was formed from within to 'slow down' the process after the IPD agreement was signed and that the team would benefit from more clarity around design and innovation goals."

Championing innovation at the scale of the software business, Autodesk's project manager strongly believed this project could advance a future in which software could help holistically manage design, construction, and operations. He acknowledged that the operations side is currently the weak link: "A bi-directional model is where we need to go to fully extend BIM to the owner/operator of buildings. Someday. A living model that extends the rich data sets that are in the model and becomes useful information for facilities staff to operate their building. It's going to take some passion on our side to get this done and I think we will get there, but it's a natural extension of BIM." Through his advocacy and support, the team used a wide range of software tools on this project.

- Autodesk has strong executive-level support for IPD.
- Autodesk's business is oriented to lead future practice, and this project was seen as an opportunity to be a model for advancing those values.

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Decision Structure

The team believed the PMT, the senior management team (SMT), and the project implementation teams were largely effective and worked as planned in the IPD contract. A major improvement to the decision-making structure resulted from the PMT’s suggestion of a program and design approval group. Autodesk embraced this idea and created two owner groups, the Building Advisory Team (BAT) and the P6 (so named for the six members of this executive advisory group). The BAT worked with the team to define the program, while P6 directly supported Autodesk’s project manager in an advisory role. Consigli’s project manager believed the formation of those two groups was beneficial, but observed, “I think we’ve had some challenges both in terms of timing and having decisions stick. Instead of having one person who can make decisions, it’s been a longer process because there’s more than one person involved in making them.” He believed P6 was helpful but missed the expedience of a co-located single decision-maker: “Ultimately, [the P6] was still decision by committee and was slower and less agile than the project required.” He identified a major challenge to the team originating early on in the project: “Not having a strong, clearly defined leader in the owner at the beginning who could help to pull.” SGA’s senior partner has had experiences with similarly complex clients: “This often happens with corporate clients—you have a representative of the workplace-strategy team and then you have an end user. This creates a situation in which everybody is the client, and it can be confusing to determine who’s helping drive the decisions. One of our challenges earlier on was identifying where programming decisions and design approval were coming from—these difficulties initiated the P6 and the BAT. These groups helped give more definition of where programming formation and design approval lived in our project.”

The early uncertainty with the owner’s program and design decision-making most affected the designers. SGA’s interior designer commented, “Because the program and the decision-makers changed, some of their goals changed, and that influenced the design in different ways. So we went back to the drawing board on a lot of things. We threw out a lot of fun ideas, but some of the ideas and concepts that we had early on in the project we still carried through. Eventually, we understood that some of the goals changed, so we switched gears to meet new goals.”

Trade partners who were part of the PMT believed the PMT was effective in making decisions but that the P6 structure was opaque and “convoluted.” One recounted his frustration: “The PMT hasn’t really been privy to [the P6’s] meetings, and we don’t always exactly hear the internal workings....I would have liked to have known more.” Autodesk’s project manager and others on the PMT acknowledged that not all of the members were a part of all of the decisions, and while this frustrated some team members, streamlining decision-making was also important.

The team co-located two days per week, and all signatory partners attended meetings. According to JLL’s project manager, the team approximately doubled their efficiency with small but important changes focusing the agenda: “not getting too far into details, not having the architects sketch out ideas during a PMT meeting, and having people communicate more outside of the PMT weekly so they’re more prepared when they come into the meeting.” He observed that later meetings were typically forty-five minutes and more productive than the two- to two-and-a-half-hour meetings early in the process.

The risk registry was maintained by JLL; Autodesk’s project manager explained the point of view of the PMT in managing the risk registry: “We spent quite a bit of time on the risk registry because there were just so many unknowns. We saw it as a protection factor because we knew there were some things that we wanted to protect for the team. There were seventy or seventy-five items on that risk register, so it was quite large.”

- The major challenge for the team was “not having a clearly defined, strong leader from the owner.” This caused problems early in the process, which later improved.
- The owner adjustments included the creation of an advisory group called P6. This helped provide authority for the project manager, but some on the PMT felt the addition made the decision process “convoluted.”
- The team struggled to find the right mix of people at the table for decisions; the team improved in reducing the amount of time of some meetings and increasing their effectiveness.

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On Board & Off Board

Generally, there was very little personnel turnover. When new people were added to the construction phase, they went through a comprehensive on-boarding process to IPD and the project. SGA similarly offered internal on-boarding for new project team members, which, for SGA, was a daylong process.

The most significant addition was the digifab-equipment consultant for the BUILD Space. JLL described the sequence adding them to the risk/reward pool: “Although they were a part of the initial agreement, they missed out on the IPD workshop the previous November by more than a month. It would have been hugely beneficial to have had them there, but it would also have been just as beneficial to have had them involved in the project from day one and then really hold off on our IPD execution until later.” He continued, “The value of having them in the poly-party is the coordination that they bring to each of the important elements in the build space.” Since this type of trade partner/consultant typically does not get involved with IPD, additional education was needed.

- Generally, there was little turnover of personnel on this project.
- On-boarding after the initial project training was handled by the individual companies.
- The addition of the digital-fabrication-equipment expert occurred after the team had gone through IPD training. This type of consultant is not typically included in a signatory role, so education was needed.

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Clarity of Goals

Overall, the goals for innovation and design were inspiring to all of the team members. As a business that is based in the AEC industry, Autodesk’s project manager “gets excited about seeing partners getting excited about our technology and its use on projects.” SGA’s interior designer said that working for Autodesk was “inspiring because we are technically their client as well, when you look at it. We’re coming to them asking, ‘Where do we think our industry is going?’ And that’s what this space is really about—where the industry is going. That’s what the concept was and what we wanted the space to showcase. We’re almost talking for our industry. They allowed us to be innovative and told us to push the envelope, which most clients don’t do. It was definitely inspirational to have them as a client in that aspect.” SGA’s virtual design lead agrees, “It motivates teams to say, ‘Look, we know what we can [ideally] achieve, now let’s see what we can do [in this situation] and work with it.’ Team Autodesk was very open about access to the [software] project teams and developers, and we were inspired in a lot of ways by them and vice versa.”

The RFP discussed the potential for developing metrics, but in the end, team members did not believe there were metrics specific to the project other than the KPIs. The original KPIs developed by the PMT included factors such as cost, schedule, innovativeness, effective use of Autodesk products, effective use of Lean/IPD processes, and overall quality and functionality. The final KPI score sheet was developed and scored by the P6, then given to the PMT for confirmation. These KPIs are: programming (meets needs), digifab element, design goals, business goals (magnet for AEC, attract employees, exhibit the future), design quality, user satisfaction (based on focus-group feedback). A P6 group member believed that, generally, the KPIs for this project was

much more sophisticated than in the Waltham project, which was limited to cost, schedule, and a simple design-quality comparable.

P6 members commented that their contribution helped ensure that the design and innovation goals were met. Toward this end, the P6 group developed a simple yet sophisticated matrix of KPIs, which could supplement the KPIs developed by the PMT, that would address many of the cost and schedule goals. After the revised KPIs were in place, the P6 group convened regularly for decisions and general oversight as well as to provide “IPD therapy” for the larger project team.

JLL’s project manager compares the two groups of KPIs: “The KPIs that were developed by the IPD team were very much rooted in delivery. If I compare them to a developer who’s developing a site or interiors or whatever, their end goal is really about ‘Am I on time? Am I on budget? What was this move? Did this work? Did we find efficiencies?’ That’s what we had focused on as the IPD team because that was our natural area of focus. Then the owner, with additional input, mentioned, ‘We need to make sure we hit our innovation requirements.’ It was very clear, but it’s another layer, a different perspective that we needed to bring to IPD.”

To meet one of the KPIs, team members were expected to produce white papers on aspects of innovation used in the project. Trade partners, especially, felt finding the time to document their work a challenge. Team members understood the importance of the marketing and documentation aspects of the project and believed that the nature of the project goals would be inspirational to the building industry.

RFP GOALS:

- Create an environment that presents the breadth and depth of Autodesk applications in an atmosphere of teamwork, partnership, and expertise.
- Use IPD to integrate people, systems, business structure, and practices into a collaborative process.
- Achieve or improve on the proposed schedule and assure that long-lead or time-sensitive project elements are identified and planned for accordingly.
- Accomplish project at or below the target cost, set in the multi-party IPD agreement.
- Obtain LEED CI Platinum Certification.
- Achieve design-and-construction quality that reflects the owner’s position as a leader in the AEC community.
- Demonstrate creativity and innovation in project outcome and in the processes utilized to achieve those outcomes.

- Autodesk’s overall business goals for advancing the building industry and the specific goals to use this project to advance digital fabrication were very inspiring to the team.
- The PMT developed KPIs based on their understanding of the owner’s goals.
- The internal owner advisory group believed that those KPIs lacked definition around innovation and design, and developed a second set of KPIs with a score sheet.

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Resources & Facilitation

There were two workshops early in the process: one on IPD and one on Lean. The lawyer’s IPD expert and a senior Autodesk executive very experienced in IPD, led the IPD workshop. Later, the Autodesk executive became one of the P6 members. A senior Lean expert from Consigli led the Lean workshop, and while some team members commented positively, others didn’t feel that it had much impact. In general, team members believed there was greater value in supporting IPD through their informal interactions than formal training. They agreed that Lean was less discussed than IPD. P6 members believed that the team would have benefited from IPD training beyond what they received.

Two of the P6 members felt that there was not sufficient IPD training for the team, and the contractor agreed, describing the training as taking place infrequently, “not really getting everybody solid on how to do it, and then not reinforcing or doing it on a regular basis.” While Consigli had three or four people with Lean expertise, the project manager stated that there wasn’t “a critical mass of people who really wanted to make it go.” Consigli’s project manager summed up his belief about the initial training and the follow-up training: “You can go to a three-day thing like that and have it fall apart....You have to have a solid nucleus to create some gravity to keep everything pulled together and cohesive.”

The IPD coordinator on the project from JLL thought that they could have done the Lean training earlier for the whole team to become more efficient, as he saw that the later Lean training with the construction foremen was embraced and utilized. Furthermore, the team had planned on having an IPD refresher during the process, which did not take place, and in retrospect, they thought it would have been useful.

The senior architect found informal peer-to-peer coaching to be effective. From what he experienced, “There was definitely coaching. It was usually somebody who was familiar with IPD [from Consigli or SGA] being asked to have a private conversation with someone. A team member would come up and say, ‘Geez, I don’t think [this other team member is] really getting this.’ And we’d just pull [that person] aside and say, ‘You know, this is a little different. I know it’s a little different.’”

- There were two three-day workshops early in the process, one on IPD led by an internal Autodesk expert and an outside expert, and one on Lean led by an internal expert from the contractor.
- Most team members believe that additional training throughout the project duration would have been valuable.
- Informal coaching worked well, usually done by people from the architect or contractor companies who were more experienced with IPD.

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Tools & Processes

Of all the team members, the trade partners saw the most value in Lean: “Lean is the way of the future, and everybody, especially in Boston, is pushing for Lean as much as possible. I know in our company we’ve expanded...created a prefabrication shop to build things off-site, working with the general contractors to deliver equipment in a timely fashion directly to their work area versus having it sit on the project for time. So Lean has been important on this project as well as on all the projects that we’ve done in the last two years. Lean is definitely coming, and becoming top priority.”

Another trade partner appreciated the quadrant organization Consigli set up: “Consigli does a good job of pushing the project in a very Lean fashion. They drove the project to actually be Lean by working with [location-based planning]. That way, not everyone’s scattered all over the place and getting in each other’s way. You’re working in this section; when you finish this one, move onto the next one. And it worked out well.”

The team collaborated on developing co-location rules to help structure the two days everyone was on-site. They found great value in the visual materials for pull planning and reliable promises posted on the walls of the co-location space.

- Location-based planning was effective.
- Trade partners were the most positive about the effectiveness of Lean, noting positive results from prefabrication.

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Lean Effectiveness

Consigli's project manager believed that Lean was very effective in the construction activities but did not think the Lean processes were used as effectively as possible in the design or planning stages. Upon reflection, he named many Lean tools that were used but none that reached a high level of impact for the team. For example, performance metrics, Plus/Deltas, conceptual and continuous estimating, risk and opportunity register, target value design, cluster groups, set-based design, Choosing by Advantages, A3s were used, but not particularly effectively. The project manager believed that additional training would have helped support increased use.

- The team felt some Lean processes were effective. The contractor, who was the Lean leader, did not believe the team used Lean effectively.
- Several tools were introduced, but none were carried through consistently or found to be effective.

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BIM

Autodesk's business position in the AEC industry and the prominence of this project made BIM a natural fit. Using of innovative software was a well-understood owner goal that made the team feel that they were advancing the cutting edge of the building industry. The Autodesk project manager acknowledges: "We probably, in hindsight, bit off a little more than we could chew. Because we kept saying, 'Could it [software] be used here? Let's do it. Let's tell the story.'"

Autodesk saw the project could help them experience the value of their products as a building owner. As an owner, this project was the first experience seeing their contractor use point layout and Autodesk ReCap for progress scans and a visual timeline. The team appreciated Autodesk's support to troubleshoot and adapt software. Use of innovative technology was such a high priority that the team was willing to sacrifice productivity in order to learn new systems. SGA's virtual-design lead offered an example: Autodesk "had new ways to be working collaboratively on my central server that's cloud based. At the time, we were working on beta software. We had to work through quite a few issues just to get the team functioning well because it was early software. But you'd make some of these sacrifices in order to achieve those innovation KPIs."

The architect's virtual-design lead was excited about the use of technology but faced challenges with the transition to a new project management platform when access to the data took longer than expected. In the interim, they "ended up putting together different tools ad hoc, and then jumped into another communication platform that helped solve other communication issues." The number of platforms and interfaces was difficult to track. Consigli's project manager, recalled, "Maintaining multiple databases is hard, but also

where is the real [most current] information?" The resourceful team used hard-copy markups with parallel electronic markups: "We've got stickies on the wall and BIM 360 Plan and Excel."

Overall, Consigli believed the use of technology was positive: "There was a lot of success around BIM on this project. We had a lot of tools to play with, and they've all been pretty effectively used. There's also been some good, clear communication around what the owner wanted, what the client wanted to see, from the beginning, through the middle, and to the end. This created a strong vein of success throughout the whole project."

Regarding the aggregation of information in BIM 360 Glue, Consigli's project manager said, "It's where we were going anyways, but this helped confirm that this is really what we should be doing. One of the things that I liked about this project in terms of BIM is that we asked, 'What are we going to do with it at the end?' You put all this effort into creating models, and putting them together, and meshing them, and adding information to them, and then what happens to them at the end? A lot of owners aren't able to consume the information that we put together. We had a good conversation with these guys about what they wanted to do, and what they wanted to use, and what tools, and what information needed to be embedded. They set reasonable goals that we definitely hit. So it's been a good process. It's been practical, fair, and achievable."

SGA's virtual-design lead pushed beyond a traditional BIM-execution plan: "Why don't we think outside the box instead of just looking at BIM forms, level of development, and matrix, and build up our plan. Let's see if we should split the

levels of detail [LODs], and also have a better handle on the deliverables of those LODs, and tie those back to our BIM uses." He believed the innovation KPI should connect with the BIM, making this link required a different mind-set: "We discussed that [link] early on and many times. Sometimes the technical people, who understand certain pieces of the software, don't understand the big picture of what we're trying to achieve with KPIs. [The BIM technicians] may ask, 'Why do you have to care what parameters we have?' Well, we do care."

The contractor and architect handled the majority of the BIM coordination, but the trade partners were also involved. They generally appreciated the effectiveness of BIM but found some issues with the tracking and project management. One subcontractor noted, "There was a lot of tracking software besides BIM. BIM was very helpful. But when you have a lot of programs trying to track what everyone's doing, and there are four or five different programs tracking, it gets a little too convoluted. You've got about a thousand emails a day from each one."

- Team members appreciated working directly with the Autodesk software developers and were inspired to be part of advancing cutting-edge technology.
- The plethora of tools was challenging to manage.
- Overall, the team believed they achieved success around BIM and software tools.

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Workplace

The project team shared a Big Room located in the building, close to the construction site. The size of the project did not warrant full-time co-location, but the team chose two days per week to co-locate. There were some initial problems with the co-location space: at the beginning of the project, it was not available; and when it became available, noise from the cooling fans was intrusively disruptive. Eventually, the room became conducive to working, and the team settled into a productive and extremely effective rhythm. Several members of the team commented on the value of co-location and regretted the delay in having access to a functioning space. The senior architect believed that the overall project schedule would have been shortened if co-location had been available earlier and calls it his number one lesson learned: "If somebody pulled me aside today and said, 'We're gonna do this project, and we want it to be an IPD project.' My first volley back to them would be 'Great. Do you have a co-location facility, and can it fit the entire team?' and 'Can we be in co-location space on day one, including the time that we're negotiating the contract?'" SGA's virtual-design lead described the benefit of co-location to establishing a team culture of accountability: "You have different people who maybe don't have that experience, or they're used to just working in their offices. Not used to other people in a co-location environment. You're exposing them to a lot of new things at once, and when you're pushing a deadline, you realize that you actually have to make really reliable promises." Consigli's project manager believed the limited number of days limited the effectiveness of the co-location. He believes that other projects in his experience were "overall more collaborative in some ways than this one. A part of that, to be fair, is the difference in scale. One of the things that was interesting is that two days a week of co-location is not the

same as really, truly working together day in and day out. So it's largely about the size of the project. I know there have been some questions in the industry in general—and I've had them as well—about what size makes sense [for co-location]." He believed the months they spent with the loud cooling fans impaired the team's ability to collaborate: "It really put a big noise blanket on top of our collaboration. We were in a space together, and we couldn't actually communicate because it was so noisy." People acknowledged the noise problems, but since their time in the co-location room was limited to two days, they were not very motivated to address it. Eventually, the weather cooled and the fans were shut off. Of the delay, Consigli's project manager said, "In my opinion, honestly, it was a critical mistake. We should have corrected it immediately. I honestly think it would have made a big difference in terms of culture and communication."

SGA's senior architect saw enormous value in the visible documentation posted in the co-location space. In fact, the physical documents replaced the need for virtual ones: "I'd say that when we weren't in the co-lo, we used Trello [project management software] pretty well to manage communication. But as soon as we got to co-lo, people stopped using it. We didn't have to ask, we were right here and we were talking. We'd write things up. We all had whiteboards at one point before we started painting samples on the wall. We organized into groups of designers, contractor, subs, and at the end of our workstations we had a board that people could put important, relevant information on. We all had a whiteboard like that, and the interior designer and I would write down what we needed from people. They would write down what they needed from us. We communicated a lot on the whiteboard."

- It took some time for the team to have a fully functioning Big Room—at first there was no dedicated space, then the space was excessively noisy.
- The contractor believes allowing an extended period of time to create a functional shared space was a mistake.
- The visual documentation and white board in the Big Room was very effective for the team and complemented or replaced some aspects of the virtual document-sharing platform.

Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
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Team Alignment

The team generally believed that they worked collaboratively and effectively. An example of the team overcoming challenges by working together was the resolution of a major floor-leveling issue in the first few weeks of the job that could have undermined the entire project. It was resolved with a cost-effective solution within a short time frame. The floor of the old building was considerably more uneven than had been anticipated, and the dimensional difference impacted many aspects of the design. Consigli, SGA, and several trade partners, including State Electric, came up with a solution to use a raised floor with variable leg heights to accommodate the irregular floor level. To streamline the delivery of materials on-site without halting the project, they developed a construction sequence in which the subtrades would work in quadrants. The solution had the added benefit of running power and data under the floor, which the owner has found both more aesthetically pleasing and more functional for team reconfiguration.

The senior architect is skeptical that the contract itself contributed to the team alignment: "We pulled the agreement out when we lost track of what we were really being held to in terms of any KPI. The other times we pulled the contract out were when we were looking at risk-register items as challenges presented themselves. We never pulled the contract out as a stick. It was always a carrot; it was never a stick. In that sense, I felt that we had good team members and we probably could have done this without [a contract]." He acknowledged that the formation of the contract deepened relationships and that without the contract there would likely have been litigation. JLL's project manager believed the contract did relate to behavior: "The more you can create in your decision-making [process] and your risk/reward, the easier it is to help drive the other members who are lower

in the pyramid." The trade partners perceived a difference in their approach because of the contract: "On the typical project our contract is only with the subcontractor. Here, [contracts are] combined together, and our profit and KPIs are based off of that [joint agreement]." Because of the opportunity for dialogue and his motivation to meet the KPIs, one of the trade partners challenged the engineer: "On the sixth floor down to the build space, the engineer put on their regular spec. I questioned it, stating that we did not have the money in the budget to handle that and asking, 'What is the actual need for it?' We were able to reduce about 50% of the spec and the cost. We had the ability to push the engineer to inquire, 'You know, why are you really spec'ing that? What is the reason for it? Are you just spec'ing it because it's a typical spec?' Everybody would like the greatest and the best product, but in some instances, it's just overkill. On my end, I push the engineers and other parties to question, 'Is it really necessary?'"

JLL's project manager witnessed fiscal discussions that helped build alignment within the team: "You have seven people, three or four of whom are really worried about MEP and infrastructure and things like that. They don't always hold the same value as the designers and contractors and the owners. So there's a bit of a challenge in getting some understanding and alignment between the group members." A trade partner commented that shared risk/reward and fiscal transparency was key to supporting effective cross-trade collaboration: "Everything was open book. If someone had an issue that I could help solve, I could do it without having going through a bunch of trouble or doing a change order, without having to say, 'This is going to cost me more money.'" He concluded that the contract "gave us a chance to work together on a team, to

figure out the best possible option as cheaply as possible to help out the budget."

- The senior architect characterized the contract as "always a carrot," never a stick.
- Trade partners expressed confidence that the IPD contract and shared reward pool empowered them to speak up on issues they normally would not have on.
- Cross-trade collaboration was supported by a shared risk/reward pool and transparent financial information.
- Reduced paperwork for changes was a positive, but increased internal accounting was a challenge.
- Cash flow was difficult, particularly for the architects because the profit payout occurred after their work was largely completed.

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Collaboration

The project manager for the general contractor believed the goals were clear in the later part of the project, but early on, before there was sufficient clarity from the end users, the owner’s program appeared “malleable.” The trade partners noted that the early phases of the project offered the most challenges in terms of understanding the owner’s program: “I feel like Autodesk knew what they wanted but at the same time they didn’t know a lot. They couldn’t wrap their head around what they actually needed or what it could be.”

JLL’s project manager agrees that the program was not well defined at the beginning: “Having a definitive program at the time the target costs were developed would have provide the team better guardrails for projecting costs.” Consigli’s project manager recalled the early programming phase: “One of the complaints we’d get from Autodesk was ‘The design team just presented something that we can’t afford.’ That shouldn’t happen. So we had a broken process for a little while, and people were acting the way they would normally act [in a traditional project]. The designers would design something, and then meet with the owner, who would say, ‘We love this.’ Then we’d take a look at it and say, ‘You can’t afford it.’” After Autodesk’s project manager explicitly said, “Don’t show us anything we can’t afford,” the team took steps to change their process. These changes were greatly supported by the creation of the BAT and P6 groups. When the program goals became clear, the architect was able to complete a design that successfully met the owner’s needs. The time spent on previous design work was a loss for the architect but the collaborative environment and IPD agreement helped the team compensate for the additional time needed for design.

The electrician understood that Autodesk wanted functional but also “fun and exciting”: “They wanted something that would stand out, something to make their employees happy.

[Something] worth making the move from Waltham for, that brings us up on new technology, and that really stood out to their employees and the public. It’s a base project they want to build off of as a positive representation of their industry around the world.” He believed this goal changed the team’s behavior: “We looked at a lot of different angles on how we could actually be on the higher end of our work product. Whether it’s architecture, mechanical, or electrical—something that definitely stood out.”

At the point when the finish line came into focus, the team became more precise about hitting the goals as they were exactly stated and wrote out the KPIs on the wall of the co-location space. Consigli’s project manager recalled that, initially, the team focused on the work at hand without having daily or weekly reminders of the KPIs. Then something shifted: “At a certain point, two-thirds of the way through the sixth-floor project, we circled back and said, ‘Wait a second. We’ve got these [KPIs] out here. We really need to circle back.’ We began reviewing them on a weekly basis.” The senior architect noted that the KPI definition had some subjective language inherent to design: “The design-quality metrics is basically the most subjective of all of them. It essentially says that it has to meet a high-quality level of design. I don’t really know what that means and who gets to decide that.” JLL and Consigli both noted that the KPIs were more clear after the P6 was in place.

JLL’s project manager believed the team ended up very much aligned: “Autodesk didn’t have to remind the team, but the team did a little self-policing, especially early on. One of the challenges early on was having [members of several companies] who aren’t typically in these types of roles, managing them into the process and [helping them]

understand the process. There were little difficulties at the beginning, then the architect said, ‘You know what? We really have to think about this. We have to pay attention and focus. Here are our rules, and this is what we’re going do.’ Everybody buys into that, so it wasn’t so much Autodesk driving but about us policing ourselves.”

JLL’s project manager believed the team was effective in planning and tracking decisions. “We did PMT package approvals. In our weekly PMT meeting, if there was something that needed to be approved, we essentially tracked what our budget was, what was being approved, and what had been forecasted. We knew where we stood throughout the project. We didn’t have updates every week, but the opportunity was there. We would get together and adjust our forecasts monthly to see what we’ve committed, what we forecasted, and where we stood. That’s been pretty helpful because we’ve run into some tough decisions, and knowing where we stood really influenced those decisions.”

- Although there were two sets of KPIs and they were well communicated to the team, the team described the owner’s goals as “malleable.”
- Early phase design goals were not clear because the program evolved.
- Later in the project, when the team was able to focus on KPIs, they were able to align around those goals.

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Team Culture

The team culture was remarkably strong considering the early challenges they faced, particularly with the need for program definition. Specific successes occurred during mid or late points in the construction. The electrical subcontractor described the IPD process as empowering: “On this project more than others, we had the ability to be influence decisions, versus a typical construction project where we don’t. Being on the electrical side of things, lighting was a big part [of the project]. We worked collaboratively with our regional distributors and lighting reps to put a package together, something that would typically be done by a lighting consultant for the architects. We had a set budget for the lighting. We brought in the lighting rep and worked with them directly to create a nice package that would work for Autodesk.”

SGA’s interior designer, who appreciated the ease of decision-making within the team, said, “It was either a conversation that would come to my desk, and we would make a decision. Or sometimes I would send someone a quick email just to confirm, or to record. There was a lot less filing back and forth.” The trade partners discussed that having the right people at meetings was particularly important when the team had to accommodate program changes: “I do like the IPD process. It worked well. But on the decision-making side, having the right people in the room is beneficial too.”

- Trade partners reported an ability to influence decisions and bring their expertise to the project.
- The architect’s interior designer appreciated the ease and speed of decision-making within the team.
- The contractor believed that the team never really coalesced due to the ambiguity of the owner’s decision-making early in the project.

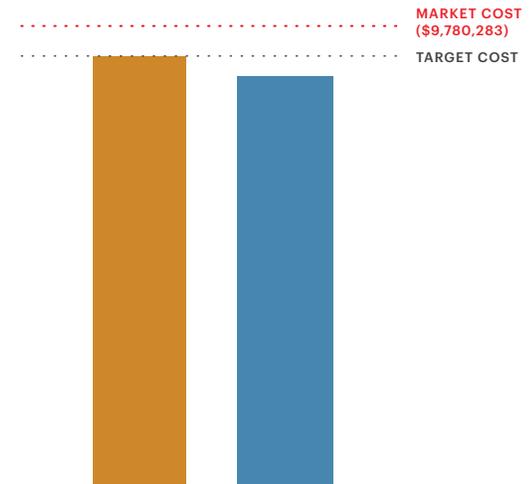
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Profit & Payout

SGA's senior architect reflected on IPD's adoption and pinpointed some of the financial challenges: "To be perfectly honest about IPD, there a couple of reasons why I feel like it hasn't really just caught fire. One of them is the ego issue for designers....The second one is just ignorance. I think people just think, 'I don't need to learn how to do that really well, so why would I change?' And then the third, for firms like us that really want to be innovative, is the balance of how many IPD projects you have on the books versus how many traditional projects you have on the books. It really is a balance. It would be hard for a firm to have 100% of their profit capital tied up in IPD projects. It would be really hard for that firm to survive from a cash-flow perspective." He went on to note that his firm is careful to limit the number of IPD projects in the office at any one time to minimize cash-flow risk. However, from the architect's point of view IPD projects are "absolutely more profitable": "We typically enjoy 20% to 25% profits. So, pretty high."

- From the architect's point of view, IPD projects are "absolutely more profitable." He estimated that IPD profits are 20–25%.
- Cash flow for architects in IPD projects can be challenging.



Allowable Cost	Confidential
Target Cost	\$9,100,000 (100%)
Final Cost	\$8,700,000 (95.60%)
Target Profit	N/A
Final Profit	N/A

AUTODESK PROJECT COSTS AND PROFIT

The office space was phase one of two planned phases. Phase one had a final project cost of \$8.7M, and was completed \$400,000 below target cost and 11% below market cost. Profit payout on phase one was not held as a distinct number.

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Budget & Schedule

The team struggled to adapt to shifting program parameters within a tight budget. Consigli's project manager said that if the program was known earlier and the team had been able to be a more strongly coherent group, "I think all the way around it would have been better. We could have done some more interesting things design-wise. I think the cost side of this would have been much better, significantly better, and the schedule too. Our schedule has slipped, and I don't think that would have been the case had we really been able to get this team together the way it should have been." On the other hand, several team members from SGA, Autodesk, and JLL commented on how well the team had been able to absorb changes and on the overall resilience of the collaboration.

For example, changes to the program on sixth floor impacted the schedule by thirty days. This delay was absorbed by team, and the owner acknowledged their changes caused the delay. Costs were also shifting "constantly," the architect said, "I would say that because of some of the programming at the beginning of this project, the target project cost on this project suffered. It has been a continual challenge to manage against that target project cost largely because the program changed a lot during the design and the construction processes. We absorbed a lot of it as well. The team absorbed a lot of hiccups. That was a part of what we all signed up for. It's still happening. We're still doing it."

Consigli's project manager is an architect who used to work for an architecture firm. He commented on the difficulty architects have in managing the cash flow in an IPD contract: "The risk/reward pool from the perspective of a firm presents a very different accounting issue in that, as a service organization, if you want any capital to run your business, that capital is typically tied to accounts receivable. Banks typically look at anything over sixty days as loss, so it's really difficult

to explain to a banker that 'No, we're really going to get that money.'"

The trade partners agreed that the reduced paperwork was a significant benefit of the IPD contract but noted that internal bookkeeping was much more difficult than on a traditional project. When asked what was one of the most challenging aspects of being on an IPD team, one trade partner said, "Internal accounting. We're not typically used to doing projects this way and doing budget adjustments [in this way]. It was a little bit beyond [what our accounting staff was used to], so there were definitely some challenges within the accounting department."

- The project in this study was phase one of a two- or three-phase project, so some information is incomplete at this time.

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Building Outcomes

JLL's project manager described why there is a delay in assessing the building outcomes for phase one: "KPIs are heavily weighted on aesthetics and innovation, and we wanted to make sure that the project was evaluated in its entirety."

From the beginning of the project, Autodesk was interested in showcasing digital fabrication. One of the KPIs developed by the P6 describes a requirement for a digitally fabricated element, known by the team as DFE, and the team struggled to understand how to address this need. After unsuccessfully attempting internal designs, the P6 approved the issuing of an RFP to known digital innovators. One DFE team was chosen, and the project team supported their concept work for a first-floor installation in the BUILD space. Yet, as the design developed, several team members began to question if it was really meeting the project needs, and that design was eventually abandoned. The team then decided to hold a competition. There were several strong entries, and two ideas for the BUILD space DFE were selected and combined. Additionally, one of the other designers was commissioned to develop DFEs for the sixth floor. The designs for the sixth floor were successful, and the elements were fabricated and installed as a part of the project. The team attributed the eventual success of DFEs to the IPD process, which encouraged them to work together through multiple failures and find a way to successfully to meet the owner's goal. JLL's project manager recounted, "We all decided that this is important. We want to have some kind of element like this. It's inherent to the project, and we need to have something like this for the project to be successful."

- The project in this study was phase one of a two- or three-phase project, so some information is incomplete at this time.
- The owner's desire for a digitally fabricated showcase element caused tension within the team, as expectations and decisions around this element were not clearly communicated.

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Project Credits

PROJECT TEAM

Signatory & Risk/Reward Pool

Autodesk, Owner

Consigli Construction, Contractor

Spagnolo Gisness & Associates (SGA), Architect

WSP | Parsons Brinckerhoff Engineering Services, Engineer

Boston Industrial Consulting (BIC), Engineer

State Electric Corporation, Trade Partner

T.G. Gallagher, Trade Partner

INTERVIEWEES

Owner (Autodesk)

Phil Bernstein, Trey Klein, Charles Rechsteiner

Contractor (Consigli)

Andy Deschenes

Architect (SGA)

Michael Schroeder, Jeff Tompkins, Amanda Vicari

IPDC (JLL)

Mark Terry

Trades

Brian Delorey and Michael Hennrikus, T.G. Gallagher (Mechanical); Lukasz Rebisz, State Electric (Electrical)

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Project Description

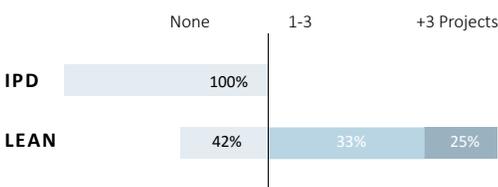
PROJECT	Mosaic Centre for Conscious Community and Commerce
LOCATION	Edmonton, Canada
BUILDING TYPE	Office
PROJECT TYPE	New Construction
CONTRACT	Custom
OWNER	Cuku's Nest Enterprise
ARCHITECT	Manasc Isaac Architects
CONTRACTOR	Chandos Construction
PROJECT START	August 2013
COMPLETION	March 2015

Project Images



Photos courtesy of Priority Mechanical

Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 12

This was the first IPD project for all of the team members and the owner. The team had a range of Lean experience. Most of the team had not worked previously with the owner, but most of the team members had worked together on one or several previous projects.

Building Size 30,000 sq. ft.



Budget \$11,355,667



Schedule 17 months design 11 months construction



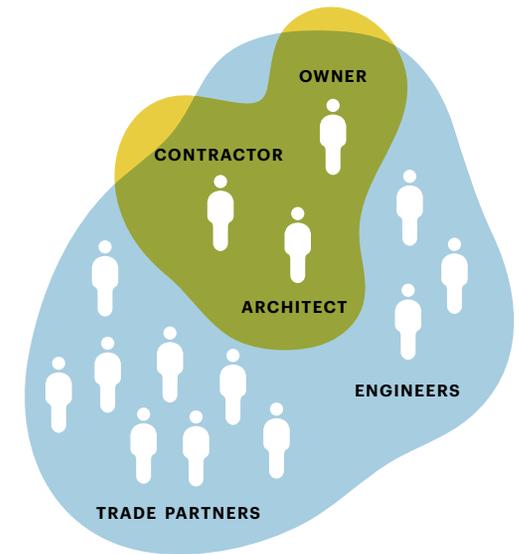
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Project Description

The Mosaic Centre for Conscious Community and Commerce is a 30,000-square-foot net-zero commercial building located in Edmonton, Alberta, Canada. A goal of the project was to be a model of sustainable construction for the building industry, and it represented many firsts for those involved. It was the first integrated project delivery (IPD) project for all of the project team members and the first Lean construction project for most of them. It was the first LEED Platinum rating and the first Living Building Challenge Petal Certification for the city of Edmonton and the first net-zero office building in the region. Overall, the project team had an “appetite for investigating better ways of doing things.” Significant aspects of the IPD project were a highly involved owner (Cuku’s Nest Enterprises), ambitious and clear owner goals directly tied to metrics—which resulted in better performance and management of a shifting project scope—innovation in building technology, additional profit incentives tied to the schedule, a high level of social interaction on the team, and the high public visibility of the project.

PREVIOUS RELATIONSHIPS

The mass-timber subcontractor had extensive experience with the structural engineer and the architect, and some experience with the contractor. The mechanical engineer had a relationship with the architect and felt they were brought onto the project because they work on sustainable and “quirky” projects that don’t follow construction norms. The exterior-wall subcontractor had a relationship with the architect and had some experience with the contractor. The electrical subcontractor often works with the contractor and the mechanical subcontractor.



MOSAIC PROJECT TEAM

The contractor was the first party to be selected; the architect had been in conversation with the owner before agreeing to join. The owner was interested in having a diverse group of participants in the risk/reward pool, but also saw the expediency of keeping the pool to a manageable number. The signatory pool included the owner (Cuku’s Nest Enterprises), the architect (Manasc Isaac Architects), and contractor (Chandos Construction). The incentive pool included three engineering consultants and eight trade partners.

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QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

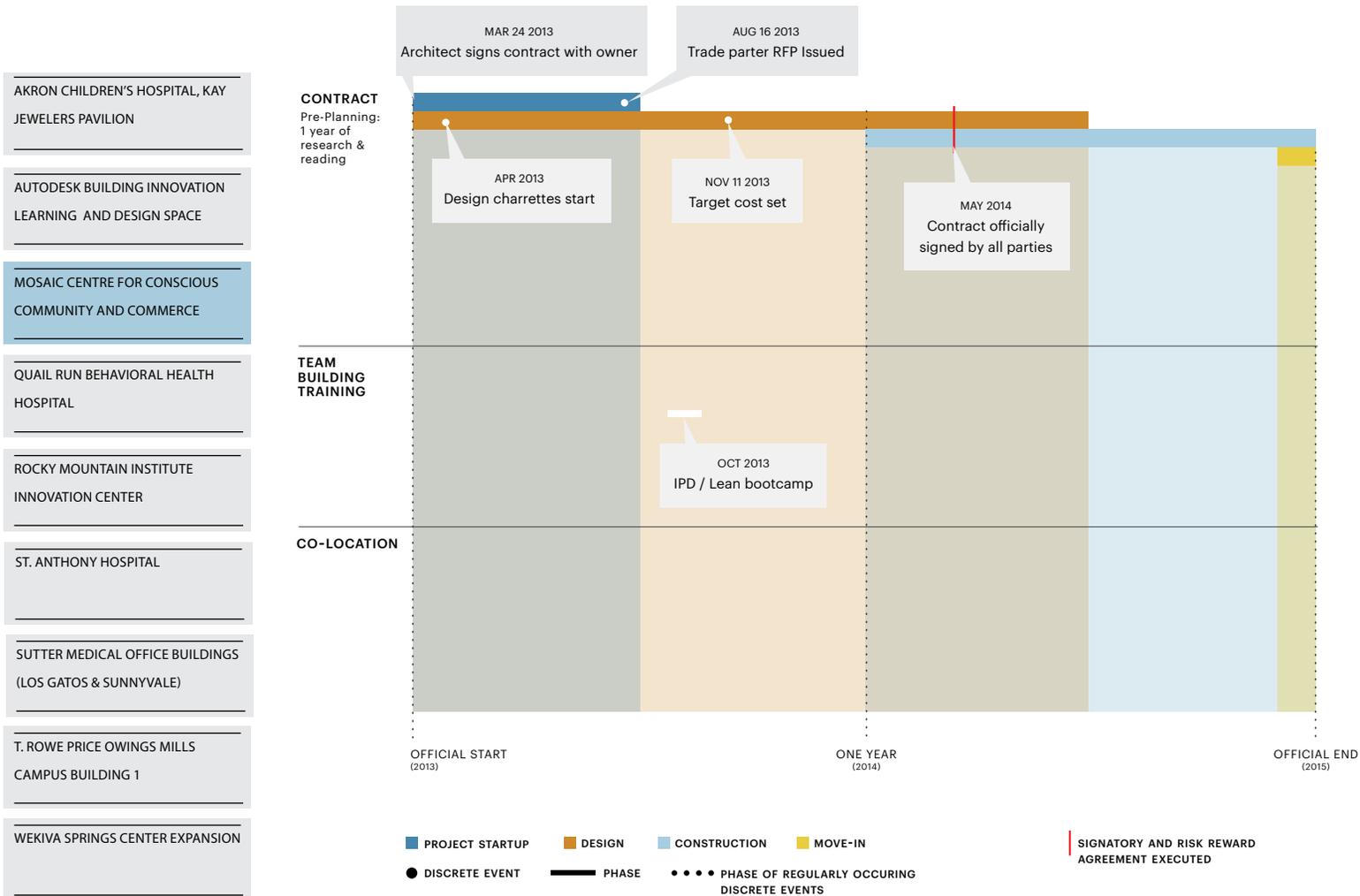
SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
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Project Timeline



MOSAIC PROJECT TIMELINE

The contract was not finalized until three months after the start of construction. This sequence of events was challenging for many of the team members; trade partners commented it started the team off without a strong foundation. However, the owner views the fact that they were not delayed by the contract as a testimony of the team's level of trust. (Note: this text is based on the interviews, the facts given by the team do not match.)

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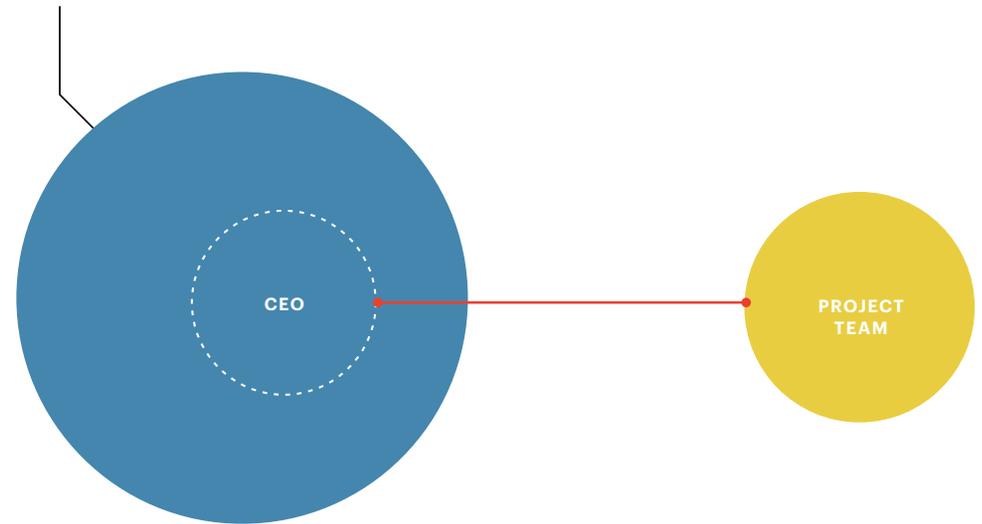
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Owner Identity & Interface

The chief executive office of the owner was the key champion for the project. He was involved in every aspect, from design through execution. He set highly ambitious goals for the project, including in the areas of building performance, business practices, design, and construction. He believed that the project was like “the chosen one.” He spread his enthusiasm to all of the project participants he came in contact with and made extra effort to personally connect with as many of them as possible. He recounted his experience with the job-site workers: “I was in the job shack, and all the trade partners were in the room. These are the on-site workers. We bought some pizza, and I told the guys what my greatest fear was. I heard one guy say, ‘Who is this guy?’ I said, ‘I’m the owner.’ It was weird. I got really vulnerable with him....I was a real person, not just a pension fund somewhere or some investment group.”

To date, the owner had only done small commercial renovations. This project was a major leap forward: “Not unlike in Monopoly, we sold all the houses to build the hotel. Yes, this was the big one.” The owner did not see himself as a standard owner: “One of the reasons why this clicked is probably that I was too naive to know it could have gone off the rails. There is an element of ‘Hey, I trust you. Let’s do stuff.’”

Cuku’s Nest Enterprise



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Choosing IPD & Lean

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WEKIVA SPRINGS CENTER EXPANSION

Delivering an affordable, cutting-edge, sustainable building was the principal driver behind the selection of IPD and Lean. As the owner described, “Anybody can build a sustainable building. It just looks like a shoebox with pinholes in it. That’s a cheap sustainable building. Or you can build a really beautiful building and make it sustainable, and it costs you 600 or 700 bucks a square foot.” He believed IPD and Lean could produce a low-cost sustainable building that met high design standards. The owner acknowledged that the very high aspirations he set could have been considered unrealistic, and, in fact, at the very beginning they were: “From the outside, it looked like a science experiment. First LEED Platinum building in Edmonton. First Living Building Challenge Petal certified. First IPD. First net zero.” In spite of the obvious challenges of achieving so many firsts, he had faith that they all could be achieved: “I knew that if we had the right team, [once] we got them going, they could go the distance, and they would deliver a beautiful product.” The owner was concerned that his high design goals could work against him if he couldn’t trust the team to understand them. He also believed that if the team perceived that the owner had a generous budget to support his ambitious goals, they would prioritize the design goals over meeting the budget constraints.

The owner had not been familiar with IPD before the project: “I didn’t know anything about IPD. But I knew that I wanted IPD, and I just had to figure out what it was.” He was struck by the descriptions of the collaborative cultures created by IPD and knew that this high level of collaboration was required to attain his aspirations for the building: “I needed something that would facilitate everyone wearing the same jersey. [I couldn’t have] the mechanical and the electrical guys in the corner, high-sticking each other when we weren’t looking.”

The owner analyzed the risk of the project and believed that even though IPD was new to him and to the team, his inexperience with the contract would not increase overall risk for the project. He believed using IPD mitigated what he believed the true risk was—not being able to find the right team for the project. “To me it wasn’t contract risk. It was getting people to play nice. At the time, the construction market was really busy here, and I wanted to get an engaged team.”

While inexperienced in IPD, the owner was very familiar with Lean, and he saw this experience as a basis for developing comfort with IPD. “One of the reasons I chose IPD is because of the heavy contingent of Lean. Lean was a part of it. The oil industry [which is his business] started their Lean journey, probably about six or seven years ago now.”

According to the owner, the bank initially felt that the risk related to the project was insurmountable. To appease the bank, he decided to include every personal guarantee he could: “None of the banks wanted to touch it. So I had to take the Rubik’s Cube and twist it up a little bit so it didn’t look too freaky, and say, ‘Forget about that. Here’s my cap rate.’ The real risk for the bank was, ‘Are people actually going to want to pay that extra \$2 or \$3 a square foot to be in this building?’ So it was an exercise in creating a sustainable building that looked good, that was beautiful, and making it affordable.” The mass timber of the structure was also an early insurance obstacle. The team had to convince the insurance company that mass timber did not have the same fire risk as traditional stick build. According to the owner, the bank now uses the building as an example of successful risk-taking: “We took a gamble on this, and it’s one of the few things that actually worked right.”

None of the team members had formal experience in IPD, and other than the steel contractor, none had experience with Lean construction. Though inexperienced, many of the team members had read about IPD and Lean and found synergies with their companies’ collaborative cultures and their drive to try new approaches that would increase efficiency. The architect did not have experience with IPD and was more strongly motivated by gaining a competitive advantage on future projects rather than by profit sharing. The firm was also keen on using the sustainability aspects of the project and the ethics it proposed to promote the company. To prepare for their first IPD and Lean project, the contractor called on external expertise to internally train and facilitate discussions. None of the subcontractors had experience in IPD. Those who had collaborative design-build experience found it was only a marginally helpful reference point since IPD decision-making and budget management are unique.

- The owner believed that his goals of affordable, sustainable, and high-quality design could only be achieved with a collaborative team culture made possible by using IPD.
- The project realized many firsts for its market context, each representing major challenges and risks; and the owner believed these firsts could be achieved with IPD.
- The owner had extensive experience with Lean in the oil industry and anticipated the benefits of use of Lean in construction.
- The owner believed that Lean and IPD would mutually support each other.

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Team Selection

The owner created a team-selection process that captured the Lean focus on producing value for the project: "You got to have the right team. You got to have everybody set up. I think we did really well with that." In lieu of a traditional request for proposal (RFP), the owner issued a memo called a "call to partners." He also produced a video that described the objectives of the project and emphasized the project's feasibility. Several team members commented that the clarity and inspirational nature of the project goals as well as the opportunity to be involved with innovative practices piqued their interest. At the same time, the highly aspirational goals were intimidating. Their first impressions, when hearing about the project, ranged from "Yeah, we want to be on this project. That sounds really cool. How do we get in it?" to "You're nuts!"

After more fully understanding the project goals and plans for execution, team members came to believe that the potential rewards offset the risk. The owner understood that the opportunity to be leaders in the industry motivated companies to participate and observed that "a lot of these guys left money on the table so they could be part of it and they could learn about IPD and learn about net-zero construction." Team members from several companies echoed this sentiment. A trade partner commented, "We thought there might be more business in the future going this way [and wanted to] see what this is all about. For us, it was more about the experience than trying to make a few bucks." Another trade partner mentioned, "We're a company trying to grow. We're more than willing to try new ideas and new things. Sometimes they work, and sometimes they don't. At the end of the day, we want to move forward with the IPD processes because that is going to be the way of the future. As far as the cost or incentive to make money, it was an

experience for us just to be part of the project, and that's how we looked at it. As long as we had our cost covered, that is what we were really concerned about."

The general contractor was the first core team member to be hired, based on existing relationships and an extended conversation with the owner. They confirmed with the owner that IPD would be the only feasible way for the project to be delivered within the project's constraints. The owner trusted the contractor's assurance that that they would invest the time and effort to build the team and provide resources to support it.

The contractor was responsible for assembling the subcontractor team using input from the architect and consultants. When selecting the subcontractors, in most cases, they recalled, "what we were really looking for was a culture. And we wanted to make sure everyone would communicate really well with their counterparts. Also, we were looking for guys that [wanted to] think differently." Sustainable-design expertise was also a key criterion in the selection process.

Among the team members, the architect was the most skeptical about the possibility of meeting all of the owner's goals within the budget. When the owner initially approached them to complete a LEED Platinum, 30,000-square-foot mixed-use office building within a very short time frame for \$9M (later revised to \$10M, then \$11M), the architect was reluctant to be part of the team. His reaction to the invitation: "Nope, not happening." The owner believed the architect was the correct designer for his team, so he modified his approach and asked a sustainable-building consultant with ties to the architect to advocate for the owner. The consultant explained that the owner intended Lean and IPD to change the dynamics

between designers and contractors. The architect was frustrated with other collaborative approaches finding that "all the standards and contracts and regulations do not allow for imagination, creativity, and other aspects that we want to govern in every project." After looking more closely at the way this project was being proposed, they believed that the underlying values would allow the project team to align in ways that would permit innovative ideas to actually be executed. It was also encouraging to the architects that the owner did not have a long list of prescriptive requirements that had no ties to the overall project goals: "[The owner] had six terms that defined six core values. That's the level of clarity that they had."

- The team selection process was streamlined to be as Lean as possible.
- Instead of a traditional request for proposal, the highly aspirational project goals and owner's values were communicated with a video and a "call to partner."
- A collaborative culture was the highest priority for selection; none of the teams had IPD experience.

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Developing Contract

Contract Type: Custom by Hanson Bridgett based on their standard IPD agreement

Overall, the team viewed the contract as different from their typical contracts yet fairly simple to understand. The owner saw a lot of room for improvement regarding the contract development and management and faulted themselves for several shortcomings, scoring themselves three out of ten when they looked back on the project.

One area for improvement was the timing of contract execution. The IPD contract was not signed until three months after the start of construction, yet the work proceeded smoothly. The owner attributed the team’s willingness to proceed in spite of the delay to the “ultra-high trust” environment in place. He attributed the delay to the fact that he is “horrible with paperwork.” Eventually, he leaned heavily on the contractor to help. The architect concurred that the minimal effect of the delay in contract execution was a tribute to the trust within the team but added that the final execution was still important to avoid everyone suing each other or doing “anything completely stupid or unethical.” In contrast to the core team, some subcontractors viewed the delay in the IPD contract as their biggest challenge. The longer the process dragged out, the more they struggled to come to terms with what the contract meant for them and how exactly the team would come together.

An American legal firm with extensive IPD experience drafted the contract based on their previous work with IPD contracts. In the owner’s eyes, “I think even our contract wasn’t a pure, clean IPD. With IPD, as I’ve learned, you have the essence of it, and then you craft a contract with the particularities of the project in play.”

The owner, architect, and contractor were the first signatories, and then the engineers and subcontractors were added to the incentive pool. The structural engineer did not believe they would benefit much from integrated delivery—because their own scope was limited—and initially declined to be included in the incentive pool. In the end they agreed to be a part of the incentive pool but have overall remained skeptical about IPD’s effectiveness in their work.

“The language is very different than our Canadian-style, Canadian Construction Documents Committee contract templates. It took a while to figure it out,” said the architect. “On the other hand, the contract that [the IPD consultant] wrote uses very clean language, relative to our standard contracts—it was written far more clearly than I would have anticipated. I realized, ‘Okay, I can kind of understand this.’”

The contractor found it easy to understand the language and the ideas contained within the contract. However, they sought more specific guidance regarding actions to implement IPD. For example, understanding the financial mechanisms was difficult, especially when it involved “relaying that information to the subcontractor so they can know what the contract is going to be like.” Obviously, it was difficult for them to explain if they didn’t fully understand it. Since the terms were so different from standard practice, everyone struggled. The contractor recalled conversations with subs discussing the confusion about how prices were to be presented and how that information would be used. Overall, the contractor observed that “the financial end was pretty tough.”

When the mechanical subcontractor’s lawyers reviewed the contract, they warned them that there were things they could “get caught on.” Nevertheless, the mechanical contractor felt even with the language that could leave them vulnerable,

they had a level of trust with the team that allowed them to feel comfortable signing the contract, knowing what they were “signing up for.” Questions they asked themselves prior to signing included: Is the project going to go smoothly? Is it going to be profitable? Is this build schedule reasonable?

The glazing subcontractor described how the project was legally laid out as “pretty easy and clear.” Though there were some items in the contract they challenged at the beginning, they saw that it “all shook loose” by the end. In hindsight, they didn’t have concerns about the contract terms.

- **Contract execution was delayed until three months after construction had started. For some trade partners this was a challenge; the architect and others were able to work without a contract because of the high level of trust.**
- **While the contract was different than standard contracts, most team members found it understandable. However, the contractor and trade partners found that it lacked specific structures necessary for implementation.**

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Developing Parties

In determining who would be included in the incentive pool, the core team primarily considered if the scope of work would involve coordination between designers and the contractors and if development details and schedules would need to be done collaboratively. As a secondary issue, they considered the scope value. They also took into consideration intangible factors, such as if the trade partner was eager to be involved and try new things.

The architect described the moment it became clear that achieving the target budget was only going to be possible with collaboration and trust: “We’re only going to get there, this target cost, if we come up with a whole lot of innovative things—and we have no idea what they are today.” The mechanical subcontractor found the delay in the contract to be challenging in setting up the financial foundation for the team. “We didn’t have a true IPD start, which has a budget developed from your business model that stays as it is throughout.”

The architect initially questioned how IPD would benefit them financially because their share of the profit pool was quite small, approximately \$15,000. They reported that the real motivation for participating in the IPD team was the values alignment, innovative procurement, and the opportunity for learning and positioning in the market. He had an epiphany about IPD: “This is totally different than construction management. This project is completely and totally about the trust and the honesty you have with your team. If you don’t have that, if you can’t be completely open book, and you can’t be completely open, down to what your overhead and profit is, then it doesn’t work.” The architect closely tracked their hours on the project and found that even though they had anticipated spending a lot more time on the front end,

they also blew past their benchmarks during construction, resulting in running over their planned hours for the project. The mechanical contractor’s scope was so extensive on this project that tracking “was a big challenge for us. We do time and material projects, but they’re much smaller, like \$10,000 and under. So to have over a million-dollar scope and track that daily [was hard].”

The team had different views on insurance. From the contractor’s perspective, “If the engineer forgot something and we have to pick that up as a team....what’s the cost going to be?” In her opinion, if the proportion of cost to correct the omission is small compared to the overall scale of the project, the general contractor would say, “Why go through insurance?” This hypothetical is particularly difficult in IPD because “you can’t sue each other, so you solve the problem and if you work together, you should eliminate that [insurance issue].” The architect saw the biggest challenge as “our liability insurance people asking, ‘Why do you want to do this? This is you sharing the risk.’ What’s actually written is that ‘We are going to share profit. We are going to share risk.’” In the end the insurers understood it better and eventually approved.

The owner describes his approach to contingency on this project: “If they went over budget, I didn’t have a contingency. I had a risk registry. I didn’t have the magical 5% that automatically gets chewed up on every building. I said, ‘No, you can’t have that, because there is no more 5%. Instead, what I’m going to do is put some of my money in the cookie jar for the soil, elevator, extra fire alarm, extra testing, all these things.’ I think I had put about \$400,000 in the cookie jar. That’s about 3.5%, and we ended up using about half of that. Every time they said, ‘Mr. Owner, we need to use some of that money,’ they showed me what it was for, and I said, ‘Yeah,

no problem.’ That money that was set aside, that part was key on my end.” To develop the risk registry, the contractor worked with the subs to make an extensive list of everything with costs that were not completely known, including items like photovoltaics (PVs), earth moving, code issues, currency-exchange rates, and it totaled \$1.2M. Knowing that not all the worst-case scenarios would occur, they estimated conservatively and set the risk registry at \$400,000. When the team finished ahead of schedule, the owner put 50% of the savings he received from not having to rent swing space (\$20,000) into the shared reward pool.

- Establishing a target cost required team members to think differently than they had in the past.
- The team realized that they had to work together and try new approaches to meet the target.
- Several companies reported resistance from their insurers adverse to the idea of shared risk.

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Champions

The owner was the lead champion of IPD and Lean on the project. The structural engineer viewed the owner as having a very good understanding of IPD and Lean principles and a solid grasp on how to employ their strategies. The engineer, in their experience, counted that as a “huge advantage of this ownership group” as compared with other owners. The team appreciated the owner’s investment of time, energy, and goodwill: “Throughout the course of the project, he was there all the time. I remember one of my foreman on-site said, ‘Oh, yeah. Dennis [the owner] came by with ice cream for everyone the other day.’ That’s Dennis. He’s there and doing his thing, and he wanted to create an opportunity to do something different in the industry. It was about making a change to how we deliver construction to an owner.”

The subcontractors believed the contractor was a leader in promoting the widespread adoption of IPD in their region’s building industry. According to the mechanical contractor, “I hear subtrades, who haven’t actually been involved in the IPD projects, saying, ‘Man, we could have explored this because it looks like it’s got some real value.’”

The team had a tremendous level of pride in the project. The mass-timber subcontractor characterized it as “a big project that we’re very proud of, and we talk about it often.” The trades were also proud of the project. The contractor believed that “that [pride] shined through in the quality of the work [of the trade partners] and just their general interest on the project.”

The contractor learned that Lean champions can come from different levels of the project and, as a result, will be changing their leadership designations on future projects: “We were always fixed on the idea that a Lean leader had to be someone

in a supervisory capacity or someone who was seen in a leadership role. But we realized that there were guys, maybe on labor or something like that, that could also show good Lean leadership. And having a different mind-set in the way that you’re approaching your own work. That was something that we really realized.” She concluded, “Lean champions—it doesn’t matter who they are. It could be the project manager, it could be the laborer.”

- The owner was the champion for IPD and Lean, and the team appreciated the time and goodwill he invested.
- The contractor is a leader advocating for IPD in the industry; many subcontractors and trade partners looked to them to champion IPD.
- The contractor believes that Lean champions come from all levels of an organization.

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- AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION
- AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE
- MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE
- QUAIL RUN BEHAVIORAL HEALTH HOSPITAL
- ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER
- ST. ANTHONY HOSPITAL
- SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)
- T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1
- WEKIVA SPRINGS CENTER EXPANSION

Decision Structure

The comments from the project designers and engineers identified three key elements that supported good decision-making: the clarity of the goals, the right team, and mutual trust within the team. Their perception was that the owner had clear goals but was open to letting them figure out exactly how they would be achieved. Even when the goals seemed too difficult, the owner would say, “No, that’s how it’s going to be. Find a way to do it.” Coming up against obstacles didn’t lead to frustration; instead, the team described a culture that inspired them to be more creative. They responded, asking, “What are the impossible things that we have to accomplish by challenging the assumptions going into it?” We ended up taking a bunch of impractical elements and pulling them together in a way that made some reasonable sense. We didn’t do it perfectly, but we got to the point where we pretty closely met the goals of the challenge.”

Decisions were made based on a value matrix. The matrix was created during design in big group meetings by refining the owner’s goals into several generic categories, which were placed on rows on a simple one-page document. They would use the tool to guide their decision, and a decision was compared against every value separately. Once a decision was made, a one-sentence description, the date, and a signature was added to the decision, so that it also became a recording document or metrics tool that tracked the content and timing of the changes. The architect stated, “Once you understand the set of values you have to make decisions on, it’s very easy to give PITs, the project implementation teams, the latitude to make decision. If it became a cost determination or a big problem, then you bump up to the SMTs [senior management teams] to make a judgment on or choose a direction based on the information.” The contractor saw that the tool allowed for more decisions to occur without the involvement of the

owner, with most resolutions happening within a week. The owner was updated later on the decisions made according to the project values: “We made a bunch of decisions without him. The PITs can make decisions because they have that piece of paper, the decision matrix. And we found that very useful; it was great.”

One example of using the value matrix was the proposal by the mass-timber subcontractor to switch some of the Douglas fir to pine. As the subcontractor detailed, “We had to prove that there was a reduced-number value there while keeping it beautiful according to the owner’s standards. That was done in a decision-making matrix that we were provided with, and if you hit a bunch of the goals in that target chart, then it was approved. There was no reason to not approve it, so that decision was made in fifteen minutes in a Big Room meeting. You sat round a table, walked it through, and then you were done.”

Several team members mentioned that the regular meetings in the Big Room supported collaborative decision-making. The mechanical engineer felt that meetings that took place later on in the project could have been more streamlined: “I would’ve liked to have seen a little bit more structure to those meetings so time was used more effectively. In particular, there were lots of questions that the architect was handling. We’d have these meetings, but then eight people would lined up to see the architect because there were so many questions.”

The owner invested significant time in the project, attending almost every meeting, during which he continually reinforced culture and goals. The owner’s budgeted time two full days a week during the first month of the project; after that, he devoted standing time to the project (every Tuesday from 1:00

p.m.–4:30 p.m.) and toured the site often in between. The owner’s perception of decision-making was more informal than what the team experienced. He describes the tenor of meetings: “We were having fun. We were solving huge problems, and they didn’t say, ‘Oh, Mr. Owner, here’s an RFI [request for information]. Can you read it?’ Instead, we’d sit together, and sometimes we’d go have a beer together. I’d say, ‘Okay, guys, what do you have?’ The architect would say, ‘We can go with this grading or this grading. Okay, that one, but it costs more money.’ I’d say, ‘Okay, well, where can we find some money in the pool?’ To which they’d respond, ‘Well, we can change from this to this or take five from over here.’ It was just fluid all the time. It was that high of a level of trust.”

- A value matrix guided decisions and freed the team to work without constant oversight from the owner. It was developed early in the process when the team looked at the owner’s goals and sorted them into categories. All decisions were discussed in the context of each category and recorded.
- The owner invested his own time in the project, attending most meetings and holding office hours.

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On Board & Off Board

AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION

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QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

The mechanical subcontractor viewed the on-boarding process as somewhat evangelistic. “There’s a lot of hype to sell this process. It’s almost required that for this project. You come in with [knowledge] that it’s another [kind of] process. Then you get excited about it, and once you start seeing those benefits and you have this buy-in, then you become part of the evangelism team—if you want to put it that way. You get to the point where it’s part of your culture to advocate for it as well. This whole idea of advocacy and buy-in is a part of the incentive to do the project.”

It was generally agreed that education about and training in IPD and Lean was very important. For subcontractors in particular, who, according to one of the trade partners, “have been doing things the same way for the last sixty years,” this was essential. “You can’t expect them to understand how to forecast [project costs]—they don’t know. You can’t expect them to create a billing template—they don’t know. They do their progress draws each month, and that’s it. If you’re expecting them to understand Lean practices—they’re not going to know that. I think, globally, we can talk about IPD, and people have a general idea of what IPD is. But we’ve got to drill back down another level, so that when new contractors and new subcontractors get involved in the IPD process, they don’t have the same learning curve that we’ve had on Mosaic. So I think as a group with IPD, we have to key in on educating subcontractors.” While the need for training was clear, the scale of the endeavor was daunting.

The mechanical contractor noted, “One thing I was always concerned with was that we’ve got these twenty or thirty people sitting in these rooms for six months, making all of these decisions. How is that going to get communicated to the hundreds of people who are going to build this?” In response

to this concern, during construction, the contractor used the required site-crew safety meetings as an opportunity to give a fifteen-minute orientation on project values and goals and what the team was trying to do.

The structural-steel subcontractor, in retrospect, would have had the site crew involved in the culture development earlier to reinforce the collaborative engagement. The contractor saw that some of the subs, even with training, didn’t fully understand the IPD model and would revert back to conventional behavior over the course of the project: “Even after all the training. Even after all the talking. Even after everything we’ve done, ten months into the construction, someone asked, ‘So when do I bill for my profit?’” My response was “Oh, man, no.”

Turnover was another issue. The electrical subcontractor, for example, experienced some personnel turnover, which led individuals being brought into the project without training. Other team members noticed the lack of on-boarding for certain subcontractors and found it a challenge. The owner noted that if on-boarding was not done well, new team members “were just doing [their work] their old way.” The team did not formally remove anyone from the project. According to the contractor, “Nobody was removed. Some should have been. My perspective on [the most serious case] is that at that point [we recognized the problem] it wasn’t such an issue. [Later], it started to become more of an issue. If the project had gone on another six months, it would have been a huge issue. I think there were so many warm and fuzzy feelings within the team that we felt it was going to be more harmful to [remove someone] than to just let it go.”

- The mechanical trade partner characterized the on-boarding process as “evangelical.”
- Education and training was considered key, especially for the subcontractors.
- During construction, the project team was quite large, so the contractor set up fifteen-minute training sessions to introduce and reinforce how IPD works.
- One potential off-boarding issue arose late in the project, and the owner and team did not want to disrupt the otherwise strong team by removing the person at that point in the process.

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Clarity of Goals

The owner’s goals were clearly and consistently articulated from preplanning through closeout. The owner found that visual communication and precedent images were effective in explaining which goals were fixed and which were flexible. The owner stated, “I had \$10.5 million [the initial budget was \$9M, later revised to \$11M]. I needed 30,000 square feet; it needed it to look like this. I showed them a whole bunch of pictures. I needed a \$60,000 green wall in there. I needed these things, and I said, ‘Everything else is up to you guys, but it needs to feel like this.’”

Several trade partners commented that they appreciated the clear goals and the open-ended invitation to offer ideas on how to achieve them. One remarked that the owner “didn’t know the process but had a specific goal in mind, and it was their job to get us on board and believe their goals. I think they did a remarkable job of that, which is how the rest of us got pulled into it and stayed on track.” Another mentioned, “I wasn’t quite sure how we were going to get there at the initial meetings. But everything was basically written on a piece of napkin, indicating, ‘This is what I want—let’s figure out how to get there.’ We knew what his vision was.”

The mass-timber subcontractor understood their role in achieving the overall schedule goals. “In order for us to be successful on the project, because we were first on the ground, we had to make sure we were on time and were done on time. That ensured that the other twenty trades coming in after us would have enough time to get through their work.”

There was a problem with the Big Room early in the project when many members of the team did not understand that their attendance at Big Room meetings was required. The electrical trade partner recounted, “I arrived to the Big Room meeting, and we sat there. Ten minutes after the start time,

[the owner] looked around and asked the project manager from Chandos Construction [the contractor], ‘Well, where’s everyone else?’ The project manager said, ‘I don’t know. They were all invited. They’re expected to attend.’ Dennis looked at me and said, ‘So you drove all the way from Calgary for this, which is costing us money, and this [Big Room] isn’t working.’ The trade partner believed that incident inspired the team to come to a better understanding of how to use their Big Room time effectively. He concluded, “It was a part of our learning process, trying to get people to understand what’s required in the IPD process.”

For the owner, the infrequency of the financial updates was a problem: “We got one report, at eleven months in. The project managers kept saying, ‘Yeah, I think we’re good.’ You need to know, is everything good, or are we going to go over the edge here?” By contrast, the contractor believed information was efficiently provided as needed: “When I asked for backup from the subs, they gave backup. When I asked for time sheets, they gave time sheets. There’s transparent and then there’s transparent. What the owner wanted was a lot more than what I think is required.” She explained how auditing had a different role in the project since the team had agreed on rates and overhead: “The contract says you do an audit. But an audit is just making sure your invoices add up. I don’t think [the auditors] say, ‘I’m going in to look at this person’s overhead to make sure it’s correct’ because [the team] agreed to [the overhead rates] during the RFP process.” The contractor has since changed their reporting to balance the owner’s need for information with the time it takes to assemble reports.

- The team reports that the owner’s goals were very clear and consistently communicated.
- The owner communicated his vision and relied on the team to come up with the ways to achieve the goals.
- Early in the project, the team did not understand the expectations that everyone would attend Big Room meetings.

RFP EXCERPT:

[Our companies] vision is to provide a better way by design and ... awesomize the experience of ... partners ... [Our] values include: trust, balance, purpose, teamwork and the pursuit of perfection. ... We’re only interested in working with partners who believe in this. If that’s you, we want you to come-in and meet with us...we’ll show you how gain/pain sharing could work. Then, we’ll ask you to give us a proposal that tells us how you think you can add value to the project...

WHAT __% PROFIT WOULD YOU LIKE TO MAKE?
 WHAT __% OVERHEAD DO YOU NEED TO RECOVER?
 WHAT’S YOUR __% BURDEN ON LABOUR?

So what’s in it for you? Firstly, this method of project delivery is the future of our business. This is an opportunity for you to lead your industry. Secondly, this project is a living case study. We will be documenting our journey with various forms of media that can be used by the team members. Thirdly, this process provides lower risk and higher opportunity than traditional delivery methods. Complex projects are challenging. That doesn’t need to be made worse by antagonistic behavior and us vs. them thinking.

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Resources & Facilitation

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Based on his experience in the oil industry, the owner had faith that Lean processes would be effective in achieving his very ambitious goals: “I knew that Lean would be the way that we would deliver the project ahead of schedule.” It was difficult to know the appropriate amount and speed of training or which individuals to include. After the contract negotiations, the team saw that some of the trade partners were uneasy about the contract. So an outside consultant was brought in to do IPD training and was later asked to do a follow-up training session.

The initial training was done by a legal expert, who wrote the project contract, and a nationally known contractor, DPR Construction, who also had experience with IPD. As the owner described, “That was our first drink from the fire hose. Here’s what IPD is. I was taking it in. It felt right. Some of the guys in the room, you could tell, were a little freaked out about it. But when they looked around, they saw that everybody else had the attitude of ‘All right, I guess we’re going to war together. Let’s do this.’ At that time, we probably had a little too much of the design done. In that sense, it wasn’t pure IPD.” Webinars were made available to the team on a weekly or biweekly basis for extra coaching, and they could attend them if they were interested.

After the first two days of training, the team was asked to bring up any issues or concerns they had with any of the other partners, but no one did. As the structural-steel subcontractor noticed, “We had a lot of interaction with each other during those two days, discussing our philosophies and our attitude toward this type of project. If you did have an uneasy feeling about anybody, you could’ve identified that in the two days that we spent together.”

The team was trained on pull planning and Lean scheduling; videos were made on how to reduce the amount of time taken for tasks. The owner saw that overall the “[first run studies] could have been quite a bit better, but you’re taking something from zero. We got some movement with it, and I know [the contractor] is doing really well with that now, training a lot of guys.” Some of the subcontractors perceived Lean training as a “huge commitment” and did not attend more than one session. In contrast, some of the team members, such as the exterior-wall subcontractor, continued to invest in Lean training within their own offices, which they viewed as easier to implement than on the job site.

The mechanical engineer and subcontractor viewed the coaching as too informal and would have preferred more structure. They acknowledge that the contractor “did a pretty good job of coaching and sharing what they knew and helping us get up to speed. Throughout the project, every two or three months, we’d sit down and have those conversations about what could we be doing better. It was informal.”

- There was an initial two-day intensive training facilitated by one IPD expert and one Lean expert.
- Informal coaching occurred after the training, mostly led by the contractor.
- Some trade partners considered the time commitment to attend training too onerous; others have built off of the training to change their regular practices.

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Tools & Processes

There were several instances of saved time, effort, and costs that the team attributes to Lean tools. The team estimated that applying Last Planner System allowed them to revise the project schedule from eighteen to fifteen months, and eventually delivered in eleven months. The owner would tell the team: “As soon as you put it on the board, you’re committing to that time.” The team did that, “and they were able to shrink and shrink and shrink.” The contractor measured the Lean wins on a spreadsheet and regularly tracked cost savings, averaging over \$2,000 per week. Collectively communicating progress was important to the team. As a part of the weekly reporting from the contractor, reports would go out to the entire team, describing each win and the resulting net gain.

The team engaged in highly visual milestone tracking through the use of what they called snake diagrams: multiple time scales could be viewed and the graphic curve of linked milestones would dynamically alter as design changes were made. On the x-axis were the milestones, and on the y-axis was time. They would track if they were above or below the milestones in terms of time. In the system, red-light alarms would be triggered if people were two weeks or more behind schedule. The architect was responsible for maintaining the snake diagrams.

The team intended to follow Paul Aker’s 2 Second Lean approach on the project, which maintains that if you fix one thing that bugs you every day, you will see an overall reduction in time navigating problems. In retrospect, the owner felt that its premise was sound but fully following through was cumbersome. He shared an example: “We had these toolbox meetings during which people talked about their continuous improvements. But it does more harm if [the improvement

discussions are] not consistent, and I think that’s what happened in this case. It was really cool at first. We had all these really cool videos made. Then it tapered off as things got busier on-site. I think it actually hurt the back end of it. We weren’t following up and asking, ‘Hey, what is your two-second improvement?’” The architect is skeptical that spending “two seconds a day thinking about how to improve two seconds a day” was an effective use of time.

The owner said, “The electrical guys were the biggest adopters of Lean. They completely changed their office around, and they changed the way that they tracked their trucks, the way they deliver materials. So they bought into that part of it.”

The client and contractors were a part of the design process led by the architect. And despite the project having very ambitious goals and challenges, the architect “felt much less stress than in another other jobs.” In their view, the process allowed them to explore many options, learning from each one: “We failed many times in order to collect all the necessary ingredients to channel our inspiration into the outcome that we believe is pleasing to the owners.” The architect views their design process as Lean, since they typically go through a workshop process with their engineers and specialists. However, in this case, they found the IPD process pushed them into new areas: “We found it challenging, following our design through into the trades that actually build on-site. It worked really well in pull planning, but it didn’t quite work in some of the day-to-day things. Even just waste and cleanup—that was really so hard to get them to think [about in a Lean way].” Lean in architectural design doesn’t always follow what others expect from Lean, since designers “need to create a mess to come up with the right

solution; investing time in search of the right design is the value add.”

The mechanical engineer would still like to see further change in his collaborative work with the architect. “The architect really had a vision for what he wanted to see. A lot of times you have to convince him to make accommodations. And he responds, ‘No, but I want to do this.’ Personally, I like to see architects say, ‘Okay, yes, we can accommodate those and here’s how we can do that.’”

Some team members offered a self-critique that the use of metrics could have been more extensive and more helpful: “We weren’t forecasting our costs on a monthly basis. We weren’t tracking our percentages of labor. We didn’t track our processes each month and set those dollars in place. We didn’t come back and look at where we were failing and how we could change that. So, to be blunt, as a general statement, we basically didn’t track it at all. It was almost a hybrid fixed-price contract/IPD, with the IPD being a part of the contract requirement. As a team we worked very well, but monitoring—that success just didn’t occur.”

- The team attributes their ability to reduce the project schedule from fifteen months to eleven month to the uses of Last Planner System.
- The contractor tracked savings directly related to Lean; they averaged \$2,000 per week
- Team developed “snake diagrams” to visually track milestones.

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Lean Effectiveness

The architect believes that the effectiveness of the value matrix was evidenced by the very small number of RFIs (eleven total) and the absence of change orders. The mass-timber subcontractor saw that they were able to respond to questions faster than on previous projects because the channels of communication were open and there was not the typical chain of command. Decisions were made informally and then documented later through simple sketches.

The mass-timber subcontractor also had previously implemented Lean manufacturing processes, but in this project they were able to use the team’s ideas to make small improvements. “We spent some money and bought extra tools so that somebody who would have had to carry pieces fifty feet would only have to carry them twenty feet.”

The team offered mixed opinions on the effectiveness of the metrics they implemented. Few metrics were taken directly from Lean processes, but several were adapted, such as tracking man-hours in relation to cost and schedule. Softer or more holistic metrics were used in some cases, such as minimizing back-and-forths by utilizing direct and quick communication, or documenting the amount of time spent helping other trades.

The structural-steel subcontractor has been using Lean practices for many years but sees the culture as the foundation of Lean that allows the tools to increase productivity and eliminate waste: “The most important thing is—and where a lot of people maybe find themselves struggling with other Lean journeys—is trying to focus on implementing tools and trying to eliminate waste too quickly without establishing a strong culture and really communicating to their team why this is an important initiative for the business and for the team. You can’t really

make any gains without the proper culture established.” He warns that focus on tools can result in misunderstanding about the reason for using the tool, but “once you get that culture in place, people have a desire to make an impact and realize they have the ability to make an impact as well.”

- A value matrix developed early in the process was valuable in reducing the number of RFIs and change orders.
- The team had mixed success with developing, implementing, and tracking meaningful metrics.
- One of the subcontractors more experienced with Lean believes that establishing the culture and approach creates the foundation for implementing tools and processes.

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BIM

The owner felt they missed a huge opportunity with BIM. “We had [modeled] the steel, the wood, mechanical, and a little bit of the electrical, some of the interior walls. It was good, but we weren’t using it on-site. It was just a really cool 3-D model. They used it to clean up the design a bit and for clash detection—those sorts of things. But we weren’t doing material takeoffs from it. We didn’t have the guys come and gather around the board.” Even though the trades agreed to do BIM when hired, the owner attributed its low level of use to some competency issues and lack of interest: “A lot of the guys weren’t interested in doing that. They’d say, ‘Here are my shop drawings. I’ll see if I have time to help you BIM that.’ A few of the trade partners were really good at it. The mechanical engineer was great. He had all the duct runs, all the plumbing runs were in there.” The owner saw that “the real value of BIM for this project would have been seeing what [other systems] were built beforehand, because there was a little bit of rework in there. They couldn’t actually see what was going on [between systems, at the scale of] little connections, or how that spiral type was going to end up at the window. The quality could have probably been a little bit better that way.” And yet the owner ultimately felt that “it would have been nice to have BIM as a tool, but I would have still gone with people over tools.”

The contractor recalled, “We had discussed from the very beginning to what extent Revit and BIM would be utilized, and we had the discussion from day one that [extensive use of BIM] is not normal [in this market]. If we were going to do this, there was going to be a lot of training and money required.” They discussed several options and concluded that a minimal approach to BIM was the most cost-effective and feasible. They focused on using Revit to “have quick visual references; to do walk-throughs, [so the owner] can walk into this room

and see what it looks like, and we’ll coordinate the MEP.” They concluded that using the model for quantity takeoffs or fabrication was not feasible because “no one on the team knew what to do with [a fully developed BIM]. The cost to get it up to that seemed ridiculous.”

The structural-steel subcontractor used the architect’s BIM to develop their own model, and they felt it helped everyone understand how the different trades were interacting with each other, such as the steel connections to the glulam. Going into the project, the mass-timber subcontractor did not have expectations for BIM above what they would normally supply: “We knew going in that we’d work hand in hand with the structural engineer and share resources and develop them all together. In normal projects, that is what we do. They’re hard-bid projects; that’s pretty much what happens anyway. We may use the architectural model to overlay and see how it works, but most of the time it’s just a representation of what they desire, not exactly what they’re going to get.” The mass-timber subcontractor noted that they used models often in design meetings.

The mechanical contractor recalled opening up the model only a handful of times in response to queries, that “in this project it was never really mandated or discussed too much about the trades using it on-site other than for coordination.” He stated, “Through the IPD process, we were able to have the consultants coordinate the model a little bit more up front for us.” The structural-steel subcontractor would bring their model with them to meetings and go over it with the architect and engineer, “basically to get a rubber stamp on it, and then just send them the drawings for the record.” Shop drawings were submitted as a formality, but the approval process was greatly streamlined when compared to traditional delivery.

The contractor held the position that BIM “didn’t quite work out” because there were so many drawings and some trade partners continued to think in a design-bid-build mind-set. The contractor project manager recalls his exchange with a trade partner who started by saying “I just bid off of what the drawing...” and the contractor’s response was, “Oh, my god, no. That’s not what you were supposed to do. You were [first] supposed see what was on the drawing, [then] talk to [the designers]. What else is there? What else is the intent?’ They [glulam suppliers] were treating it as a design-bid-build instead of a design-build scenario.” Mechanical and plumbing did some prefab work but at a level that is typical for them on traditional projects, and they did not use BIM, which was “more of a coordination tool.”

There were some aspects of the contract that were not enforced. For example, the team was required to provide an as-built BIM in addition to the as-built drawings. The owner thought, “I have the as-built drawings, but I don’t have an as-built model. What am I going to use that model for? I can go and make these guys spend \$30,000 or \$40,000, and they’re busy guys. But [being pragmatic], I’m going to say, ‘Here’s the deal. You didn’t deliver me that BIM, so later when I need it, you can come and give me a little sketch here.’ I would rather do that.”

- BIM was used, but most team members believed they missed opportunities in using it effectively.
- The owner concluded, “It would have been nice to have BIM as a tool, but I would have still gone with people over tools.”

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WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Workplace

The mechanical subcontractor saw the benefit of the Big Room. “That was something that was new to me that I found quite beneficial. In my mind there’s a little bit of a better way to make those [Big Room meetings] more efficient in terms of having the players at the table. But just having access to everybody in some format was really beneficial.”

The mass-timber subcontractor remembered the team’s first feeling of being a team occurring in the Big Room. “In the beginning there was a Big Room meeting that was very eye-opening. It was about the second or third meeting we had as a large group. After we’d had time to digest what we were going to do, it all kind of clicked. We were put into PITs, and you’re solidifying the people who you’re going to work side by side with all the way through. It was then when we really had to buy in and put that buy-in back down to the rest of the employees in the company.”

He also saw the importance of the Big Room in finding efficiencies in design by looking at other trades’ numbers and offering design changes to decrease them. “You could ask dumb questions to somebody you didn’t know; that might actually become an aha moment.”

- The subcontractors found the Big Room to be very helpful in making the team gel as a collaborative group.
- Transparency in collectively discussing the work of other trades created situations in which a dumb question could turn into an aha moment.

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Team Alignment

The owner believed that if they had used a standard contract or even a collaborative design-build delivery, “we wouldn’t be sitting in this building right now. I can guarantee you that. It would be sitting, three-quarters finished, because we had some big mistakes.”

The structural-steel subcontractor believes the contract “creates a definite incentive to buying in, being an active participating member of the team. It’s one thing to say we’re going to collaborate at a high level and do all these things that should eliminate waste within the process, but if you don’t have the contract backing it and things like the shared risk/reward, [it won’t happen].” The mass-timber subcontractor saw that the contract motivated the team to find efficiencies. “You don’t want somebody to do work twice. The way that risk/reward worked out is that the more shared work there is between different people, the more that profit pool will grow.” As an early sub on-site, they tried to be efficient and provide a buffer for the trades coming on after them. The electrical subcontractor had a straightforward approach to collaboration and incentives: “Realistically, you get the project done on time or quicker with a more collaborative approach. Then the reward is bigger at the end.” He firmly believed the contract had an impact on the team’s decision-making and collaboration in routine team interactions: “It was daily. Daily between the superintendents and the subforemen, and the foremen on-site making certain decisions or helping with man power.”

The contractor saw IPD as allowing for a different relationship between themselves and the design team. Because of the constant communication on pricing, the parameters were clear. The contractor believed that this freed the architect to be more creative: “[The designers] know what the sandbox is.

Play in it. Come up with that. So be creative. You’re not going on a tangent putting gold-plated stuff in there because we don’t have a budget for gold plated. So you get silver.”

The team noticed scheduling was more difficult with those not in the pool since they didn’t engage at the same level as the IPD team members and were often not co-located. In general, the IPD team members noted, “There was a pretty stark contrast between the IPD team members [and the non-IPD members].” Multiple team members gave examples comparing the difference in culture: “It was like there was almost some jealousy because he wasn’t part of IPD...it was just another job site to him...[he brought] his own little microculture on-site.” In another example, one non-IPD sub “did his work a certain way and he was only going to do the work that he did and not do anything extra, whereas the IPD partners were doing everything to make the project move faster.”

Though team members believed their process for determining the incentive-pool members was sound, in retrospect, the owner recommends including most of the involved trade partners early, especially those who influence the critical path. Yet the owner warns against the pool growing too large: “We did a pretty good job not getting too many people in the pool because then you have to manage all these people in design. There’s an overhead burden to that.” Team members understood that there were good reasons to limit the numbers of companies in the risk/reward pool but also saw the risk that those not included would be left out of critical project-planning information. One of their recommendations was that all members of the team, regardless of risk/reward status, have clear communication about the process, including security, protocols, and timeline. The architect considered

the inclusion of the sprinkler trade partner into the incentive pool key to the technical success of the open ceiling and other details. Because the trade partner understood the open-ceiling-design goal, they took a nonstandard approach to their interface with the curtain wall and hid a large portion of their piping.

Project-first behavior was demonstrated in a story about glulam connectors. The team looked internally to see who might provide connectors, and the structural-steel subcontractor agreed to be responsible for them. The subcontractor recalled that the decision was the result of an “analysis of what’s best for the project, rather than just pushing for an increase in our scope of work.” The mass-timber subcontractor witnessed that “in the IPD format, we did have a tremendous amount of input to get the most efficient connections and framing for the process.”

- The owner believed IPD was key to overcoming “big mistakes.”
- An electrical trade partner saw the positive impact of the IPD agreement daily.
- The contractor credits IPD for team creativity within the budget parameters.
- The behavior of the incentive-pool members was noticeably different than those of the others.

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Collaboration

The team shared a strong community culture. For example, when the concrete subcontractor was shorthanded for the day, the electrical subcontractor noticed and offered some of their workers. In another example, the framers were behind schedule, and the mechanical contractor needed a mechanical room roughed in so his crew roughed the room themselves. Pooling efficiencies was another theme: the team realized that individual trades could collectively purchase a lift, share it, and sell it after the project. Individuals would routinely check with others before making hardware-store runs. The construction team also had one central location for commonly used building hardware, shared screw sets, and built customized racks for their drills. One worker, tired of losing his marker came up with a Velcro solution for his hardhat. It was so effective, he made one for everyone on the team. The owner observed that “little things like that forced them to come together and be on the same team.” One subcontractor noted that even though helping out occurs on non-IPD projects as well, he characterized this project as “a quantum leap” in the willingness to fully engage in each other’s work.

For the architect, “Those kinds of initiatives not only save time and money, but they also inspire other team members to come up with ideas.” In terms of the cross-contract work, the contractor thought they could have used it to fuller advantage: “I think when we first went into it, we envisioned a lot more of that.”

On an informal site walk-through, the owner noticed an unscheduled team meeting and suspected there was a problem. When he asked what was being discussed, he was told a solution was being worked out and that he would be presented with information soon. The next day the owner learned that the team had discovered an unexpected cost

of \$270,000 related to the design of a structural shear wall. The structural engineer and contractor realized they had very different understandings of the wall’s construction, precipitating the impromptu meeting. During the course of the meeting and with the rest of the team, they worked out a solution that met the structural goals, reduced the cost to \$80,000, and found savings elsewhere to cover that cost. The owner recalled his surprise that a major problem was solved so quickly and at no additional cost to him: “That’s when I said, ‘All right, this IPD thing’s on.’ I started telling everybody about it, saying, ‘You will never guess what just happened on my construction project. This is crazy.’ People thought that I was making things up.”

The mechanical engineer observed, “Bringing our trades on board early allowed us to sit there with the electrician, the sheet-metal trade, and the controls trade at the table. And one example [of a beneficial decision] was centralizing the fan coils in the center of the building. It meant more in terms of the sheet-metal requirements but the trade-off was fewer runs for power, controls, and refrigeration.”

Over the course of the project, trade partners became more vigilant about the timing of their material purchases and invoicing for the purchase, understanding committed project costs were key to accurate cost forecasting. The owner remarked that the team clearly understood that additional funds were limited to a few owner-requested changes and that they could not rely on change orders to resolve issues. When he was faced with conversations around ambiguity in team member’s scope of work, he would respond, “Here’s the deal. You knew the rules. I can’t get a change order.”

The project management team conducted regular surveys every three months to gauge team members’ feelings about the project. They set scoring targets for positive team feelings and were able to maintain their goals throughout the project. The team perceived that the surveys helped promote Lean thinking and improve their processes. The contractor found the softer metrics to be helpful, noting, “We’d previously determined that fun is a driver of schedule and budget. Everyone focuses on the tools, but I think you need the people first, and then you can work on the tools. So we’ve put a lot of effort into the people part.”

The team set the goal of one major media story every three to four weeks. The project had a blog; “honorable stories” were posted to it to contribute to the legacy aspect of the project. To document the project history, the team adopted a coding system used by libraries. The team participated in public-speaking engagements and made YouTube videos of the project, which were shared both externally and internally to teach people about the project.

- There were numerous examples of trading scope and generally exhibiting project-first attitude.
- The team mitigated budget problems resulting from a misunderstanding of a shear wall.
- The team communicated stories of innovation through blogs, speaking events, and YouTube videos.

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Team Culture

The owner was perceived as the champion for creating and maintaining the team's positive culture. The architect described how the owner talked about the Big Room: "We are going to have safety," he said, "so anyone can speak freely or speak openly without judgment, without worrying about whether or not what they are saying is appropriate or not, or correct." The mass-timber subcontractor appreciated the security: "One of the most unique things is going into a meeting and knowing you're not going to get into trouble. You were excited to go there and meet with other people and try to solve problems. That tremendously helped make the culture a problem-solving culture [rather] than one that put you on the defensive." The mechanical engineer had a different reaction: "The Big Room discussions were great, but I think we should not try to kid ourselves. There is no safe room. If you disagree with a concept that everybody else feels should be on the floor, you're still going to get hammered for it."

The team also knew one of the objectives was to have fun; showcasing innovative ideas through videos or graphics was cited as something that made the work enjoyable. The architect expressed that "the relationships, the trust, the teamwork we built made it fun and enjoyable and created this emotional connection that I don't think I've ever had in a project before. Everyone at the end remained friends. There was a good rapport. The whole values alignment is huge." The contractor's superintendent believed the morale on the project "waxed and waned a little bit, but for the most part... people were involved, and you got a pretty good feeling that people were working toward a common goal. There were really no outsiders in those meetings." He acknowledged, "We had a couple of instances when people were checking out. It was more toward the latter part of the project, and we

probably should have acted on it more than we did." As the majority holder in the risk/reward pool, the contractor would have appreciated having a mechanism to maintain leverage: "As soon as the consultants were paid out, they could go, 'Yeah, we left that little piece on the table, but whatever. We're onto another job.' So is there a way to back end that a bit?"

As the mass-timber subcontractor explained, "IPD was a little bit different than design-build because we were not allowed to make all the decisions that were the best for us. You had to make it best for the group." The glass subcontractor described how the contract created a different social culture: "Typical fixed-price contracts tend to be very self-absorbed, and you're really just worried about your own dollar. You really don't care whether the mechanical guy's losing his shirt, because it doesn't affect you. So it's interesting when you're in a social situation where something's affecting you, or some other person is going to affect you. You start to be concerned about what they're doing, their progress, and how they're handling themselves."

The architect saw that sharing expected profit numbers brought significant trust to the process. "You are asking everyone to put their cards on the table, and then you agree, 'If we all work together, we are going to be better at this.' So you have to have a completely open, honest, trusting relationship. Not just with the owner and the contractor but with every single person who signs up for the IPD process."

Several of the team members relayed comments about learning IPD: "It's like the first time you ride a bike, you're going to skin your knee. Everyone skinned their knees a little bit. It was a tough project to start with." Many members of the team are working on another IPD project together, and they

feel they are continuing to climb the learning curve together. The team polled the different stakeholders after project completion to see if they would want to do the IPD process again. According to the mass-timber subcontractor, "There was a resounding yes, yes we would." He continued, saying, "Profit aside, it was a project that I think everybody felt closely a part of. They felt more valued—the project manager and detailer, down to the worker, all the way through. Everybody got a part of the wave, and they enjoyed that."

The importance of culture over contract was noted by a team member. "To be honest, I don't really care whether it's IPD or any other procurement model. What I care about is that the culture is in place. I would be terrified to enter IPD if I didn't believe that I could trust the people around me."

- There was a strong team culture characterized by a project-first or team-first attitude.
- The owner's goal was to create a "safe" place to say anything.
- This was the first IPD experience for everyone; they found climbing the curve together was helpful.
- A team member said, without trust "I would be terrified to enter IPD."

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Profit & Payout

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The team saw success, delivering the project exactly as the owner wanted while driving down the cost so that everyone would make money. The initial incentive compensation layer (ICL) was \$960,366 and the final \$976,483; the profit pool at the end was \$316,865, divided by the percentages planned in the original contract. The general contractor made profit. The mass-timber subcontractor had less profit on the job compared to typical projects because of the IPD format, but they were prepared for that: "Going in, we knew that the mark-up points would not be where we normally see it in our industry. That was a sacrifice we were looking to make, to experience IPD." The mechanical subcontractor also noted that their profits were lower than typical. The architect made a small profit.

The majority of the team members felt that they did not sufficiently budget their own time for the project. The owner underestimated his time for the project because he created many of the communication documents. Chandos's project manager noted that since this project, they have radically changed their business model but still often underestimate the time required. For one project manager, the time he devoted to support one IPD project could have supported two or three traditional projects.

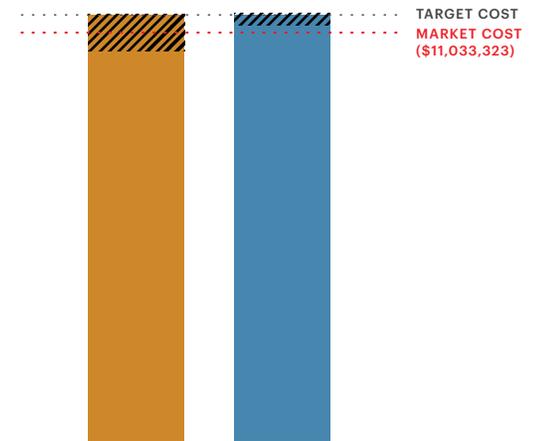
Continuity of involvement was also important. For example, the estimator was assigned to continuously supply the team with cost feedback on decisions throughout the project. The architect learned that on future IPD projects, they will map people to time and expectations according to different phases to make their time more effective. They spent two to three times more time on-site but saw major time-savings since the documentation during construction administration was minimal.

The mass-timber subcontractor noted: "With the increased time needed on the front end, we felt that a lot of our senior people were not effective on other projects." Their senior people were needed for decision-making on this complex project but their time was not always fully utilized: "We would go to a meeting at the architect's office with everybody, and it would be an eight-hour meeting and we might have only been needed there for half an hour. If you look at it that way, it was kind of a waste of time, that we were charging a consult fee but had to sit there in case some window guy came up with an idea that was good for construction." The structural-steel subcontractor also invested time early and benefited from the efficiency in the schedule later on. Their suppliers also saw time savings since RFI paperwork was replaced by simple queries to subcontractors after the weekly meetings. The mechanical subcontractor moved many of his hours into the firm's education and promotions budget rather than into the project budget because they knew it would be skewed due to the learning required in the process. The mechanical engineer saw time in meetings as comparable to design-build, but more time was needed for the learning seminars and for tracking time and material costs. The electrical subcontractor budgeted sufficiently for their senior manager and designer, whose hours were mostly used on-site, but this allotment was not enough for their site personnel to be involved in all of the daily meetings.

MOSAIC PROJECT COSTS AND PROFIT

The final project cost of \$11.36M was equal to the target cost. The profit payout was approximately \$317,000, just under 3% of the final project cost. The owner's contingency (set up as a risk registry) was about \$400,000, and approximately half of it was used on the project; \$322,000 was added for owner-directed changes. The owner had originally established an allowable cost of \$9.5M, but he quickly realized that he needed to increase this in order to meet his desired scope.

- Several members of the team made smaller than typical profit but felt the investment was worth it for their first time experience of IPD.
- The majority of the team misjudged the amount of hours, phase of expenditure, and/or the level of personnel required.



Category	Value	Percentage
Allowable Cost	N/A	
Target Cost	\$11,355,667	100%
Final Cost	\$11,355,667	100.00%
Target Profit	\$960,366	8.5% of Target Cost
Final Profit	\$316,865	2.8% of Final Cost

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Budget & Schedule

The project benefited from planning time before the project start. A local developer offered the owner an additional year from the original plan to develop the site, and the owner added six months to his pre-design schedule to find the right team. He believed the up-front investment contributed to project completion in eleven months, 25% faster than original schedule of fifteen months (which was based on a typical delivery for a project of this size and scope). The schedule was collaboratively developed. During the construction-phase pull planning, every trade had their site foreman present at both the weekly updates and three-week look-aheads. The structural-steel subcontractor said: "Having the guys who are actually going to be doing the work involved in creating [the schedule] keeps them accountable as well. It wasn't like we had individual schedules. It was all done as a team."

The team overcame major schedule challenges, the electrical trade partner said. "If we weren't doing IPD, there was no way he would have been getting this building on time. Not a chance. Because we had some hiccups out of the gate." One of the early challenges he and other trade partners experienced was the fluidity of the early design ideas. While he was unnerved by the lack of traditional documentation and approval processes, he also appreciated that IPD allowed the team to be nimble and streamlined: "If we had to wait for paperwork to come in, there's not a chance we would have been done on time. That is one of the nice things about the whole IPD process, that you just push through stuff." While acknowledging their success, some team members thought the team could have done even better. They believed that more effort developing processes to track time and materials, on a daily or weekly basis, would have allowed more feedback and chance to adjust, improving the schedule performance even more. Specific factors contributing to the schedule

savings included the relationship between the contractor and consultants, which was streamlined and which helped push the schedule. The owner attributed the schedule savings to the use of Last Planner and keeping Lean practices on-site: "We allowed the guys to bring one or two weeks' worth of material to the site, so we weren't storing and moving things around."

In the final stage of the project, there was enormous pressure to complete on the shortened schedule. The owner moved into the building while there was still some painting, commissioning, and deficiency work to complete. The owner was willing to work with the early move in since it was expedient in terms of the lease on his previous office space. In hindsight, several team members commented on the inefficiency of allowing semi-occupancy in the final phase of the project, causing work to be completed while the building was partially occupied. Team members mentioned that the decision for the early move in was made without following the collaborative decision-making protocols the team had developed, and because of this, consequences had not been considered.

The contractor noted improvement over time in managing the budget. They believed that the improvement came from sharing information in a way that was open, "very detailed, and quantitative." They saw the use of the validation study as the best way to communicate with the owner about what was in the project and what changes could lead to additional cost. In the future, the contractor will use the validation study to provide a more detailed budget breakdown, which they believe would have alleviated pains that arose later in the project. To facilitate the budget breakdown, they would have the team do more sketches of details "because that's

where most of the money is." They would also focus more on mapping out the process in order to allow all of the trades see and engage in ways to change their approach. The contractor went on to say, "If you're using BIM, your work flows are different. If you're using IPD, your work flows are different. Your estimating is different. Your procurement is different. Your co-location, that's a work flow. You have to map that out."

The architect would also invest more time in and attention to the budget tools and suggested that budget exercises would reduce the emotional element of budget discussions. "Because [budget exercises] weren't done to [a detailed] extent, there were some misalignments later on in the movies that the people were playing in their heads. That caused some grief."

The exterior-wall subcontractor understood that some team decisions reduced the incentive pool, but he had no regrets since there was still some profit at the end. The electrical subcontractor made their typical profit even though this was their first IPD attempt. The mass-timber contractor came close to their original budget, managing extensive structural changes with early cost forecasting and continuous estimating. The mechanical subcontractor found their profit was almost exactly as originally projected.

- The owner and team attribute solid early planning to a 25% savings in the project schedule.
- The team attributed their success at overcoming several challenges to IPD.
- The team improved their budget management as they adapted to Lean and IPD.

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ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Building Outcomes

“We knew we had a legacy project,” the owner remarked. “If we could actually pull this off, people were going to want to learn about it, and they were going to want to do it. Any technology that came in, we were willing to pay a little bit more up front, but it had to have a three- to five-year equivalent return. It had to outdo its competitor in five years.” A large motivation for the architect to take on this project was the opportunity to do the first Living Building Challenge project in Alberta. The owner did early validation studies of the glazing ratios and space planning to make sure their goal of the furthest north net-zero building was attainable. Several members of the team spoke of the project as a “wonderful” or “awesome” building.

There are numerous technical solutions that were used to achieve the goals of net zero and waste reduction measured against a three- to five-year payback parameter. These included:

- A geothermal field, which had higher up-front cost but which would cost them less to operate in five years.
- They changed the set-point temperatures, which reduced the heating and cooling loads and ultimately decreased the required amount of solar panels.
- The mechanical subcontractor combined systems he wouldn’t normally employ in the Alberta climate—a variable refrigerant flow system and ground-coupled heat-pump system. With the addition of solar panels, “the three elements came together and made sense for this environment. Each one of those elements on its own wouldn’t have made any sense.”
- The curtain wall systems were engineered to attach to the wood-framed building, which was a challenge for

the engineers who were used to working with steel and concrete structures.

The final building met or exceeded the original goals, although some goals, such as net zero, will require a full year to measure. The known achievements include: 100% daylighting in the office spaces and the reduction of the original energy budget of 270,000 kilowatt-hour to 180,000 through continual refinement. Monitoring systems generate data based on occupant load and how the building is functioning. There are CO2 sensors throughout the building. An independent commissioning agent was brought on board and employed a tool called CX Hour, which anyone could use to post information about the building performance.

The owner was very happy with the outcomes: “I had my expectations. It exceeded my expectations. I know what could have gone wrong—not so much in the contract, but with the building. We made a building that hadn’t been done before. As far as the way it looks and feels—it’s all good. There are a few really minor performance things. But, to be really honest, I’m really happy with it.” From the team’s perspective, the owner got an excellent value. In the words of the electrical subcontractor, “Obviously, he’s a winner when we can come in under budget....He got a building that, realistically on the open market, probably would have cost him a lot more money. He got an incredible building using a new process.”

The owner was disappointed that the building community took more notice of IPD than building performance. “When we came in on budget and 40% ahead of schedule, five months ahead of schedule, that’s when people started taking notice. And it was really disheartening for me because I wanted people to take notice of sustainability and net zero, but the building community’s reaction was, ‘Whoa, you built

that in eleven months?’ But when they came around and felt the building, they said, ‘Oh, this is pretty cool. You can do this for 330 bucks a square foot? Okay.’”

- The project outcomes exceeded the owner’s expectations.
- One team member commented that the owner got a building that would have cost quite a bit more on the open market.
- The owner considers the building to be a “legacy project” that others in the industry will want to study and emulate.
- The building is on track to meet or exceed its very ambitious energy goals.

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Project Credits

PROJECT TEAM

Signatory Pool

Cuku's Nest Enterprises, Owner

Chandos Construction, Contractor

Manasc Isaac Architects, Architect

+Risk Reward Pool

Clark Engineering, Engineer

Manasc Isaac Consulting, Engineer

Fast+Epp, Engineer

Priority Mechanical, Trade Partner

Ferguson Glass, Trade Partner

River City Electric, Trade Partner

Western Archrib, Trade Partner

Baytek, Trade Partner

Collins Steel, Trade Partner

Standard Roofing, Trade Partner

Metalacon, Trade Partner

INTERVIEWEES

Owner

Dennis Cuku, Cuku's Nest Enterprise

Architect (Manasc Isaac Architects)

Shafraaz Kaba, Vedran Skopac (Designers and Facilitators)

Contractor (Chandos Construction)

Tyler Ashford, Chris Frye, Mark Moran (Estimator, Superintendent, Project Manager)

Structural Steel (Collins Steel)

Ryan Collins, Greg Penny

Mass Timber (Western Archrib)

Mark Wigston

Mechanical Engineer and Contractor

Russel Clark (Clark Engineering), Derek Matter (Priority Mechanical)

Trade

Richard Neal, Ferguson Glass (Project Manager); Jason Vincze, River City Electric (Project Manager)

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Project Description

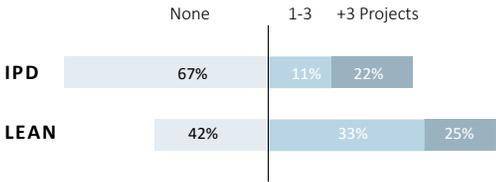
PROJECT	Quail Run Behavioral Health Hospital
LOCATION	Phoenix, AZ
BUILDING TYPE	Healthcare
PROJECT TYPE	Renovation
CONTRACT	ConsensusDocs 300
OWNER	UHS Quail Run
ARCHITECT	Devenney Group Architects
CONTRACTOR	Wespac Construction
PROJECT START	September 2013
COMPLETION	October 2014

Project Images



Photo Credits: ©Christopher Barr 2015

Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 10

Though some team members had prior experience in IPD and Lean, most were new to working with the processes and concepts. Some of the teams had worked together on previous projects, but overall this was the first project for this team, and for most, their first project with the owner.

Building Size 66,335 sq. ft.



Budget \$22,542,007



Schedule 4 months design 9 months construction



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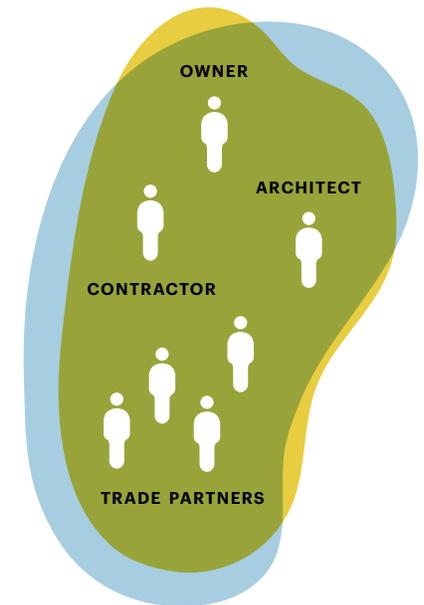
Project Description

The Quail Run project is a conversion of a four-story office building in Arizona into a behavioral health hospital for Universal Health Services (UHS), the large health care provider based in Pennsylvania. Typically, behavioral health hospitals in this region are single story, which makes security easier to manage; multiple stories required by this site posed unique programming and security challenges. The hospital owner was relatively new to integrated project delivery (IPD), and speed to market was a primary driver of their goals. One of the biggest risks on the project was that the conversion from one use to the other affected permitting, schedule, and coordination with regulatory groups.

PREVIOUS RELATIONSHIPS

Though the architect had worked with the owner on a few projects, for the majority of the team, it was the first project working together. As the owner described, "We were all newbies on this one....In this case, everybody was really new and just learning. It was a long project, so by the time we were done, we had developed some really good relationships. When I go out [to Phoenix], I call some of those guys to go to lunch or get together with them just because they're good people to hang out with." The owner also commented on how well the Quail Run project prepared them for subsequent work: "We learned a ton and took that down to Tucson [the second and subsequent UHS project completed by this team]. It worked much better in some areas; in other areas we failed."

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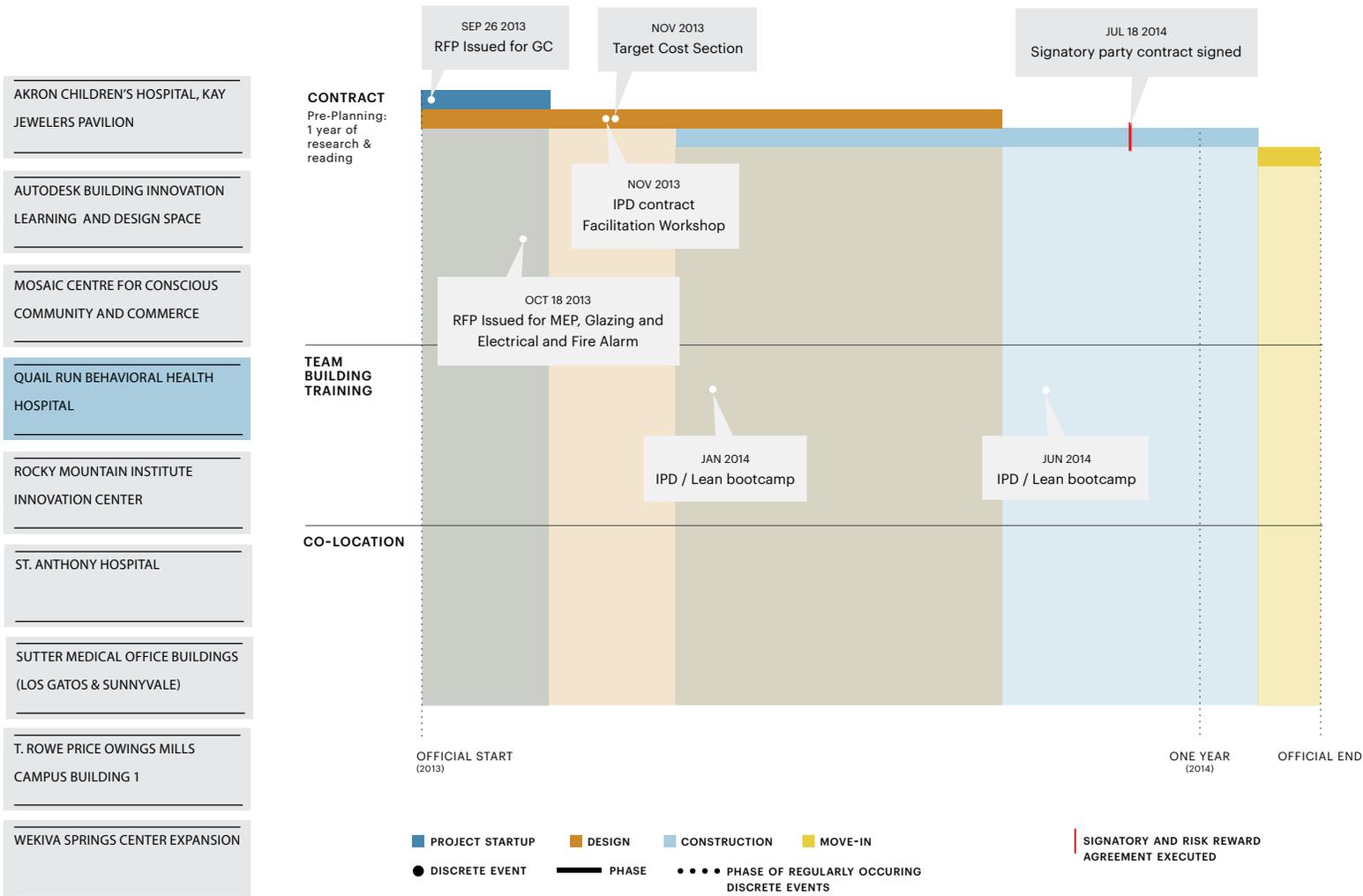
● ORIGINAL CONTRACT PARTIES / SIGNATORIES
● RISK / REWARD

QUAIL RUN PROJECT TEAM

The contractor was required by the RFP to enter in the risk/reward pool; other companies were given the choice to participate or not. The architect was experienced with IPD and observed that the contract provided great value by allowing flexibility to trade scope during construction. He believes IPD "allows you to operate as one cohesive unit that doesn't protect individual buckets of money." The signatory pool included the owner (UHS), the architect (Devenney Group), contractor (Wespac), and four trade partners.

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Project Timeline



QUAIL RUN PROJECT TIMELINE

The extended contract discussions meant that the agreement was not fully executed until construction was underway. While the owner was very satisfied with the team management of budget, they were less successful in the management of the schedule. Most of the schedule issues arose around interface with the city permitting process.

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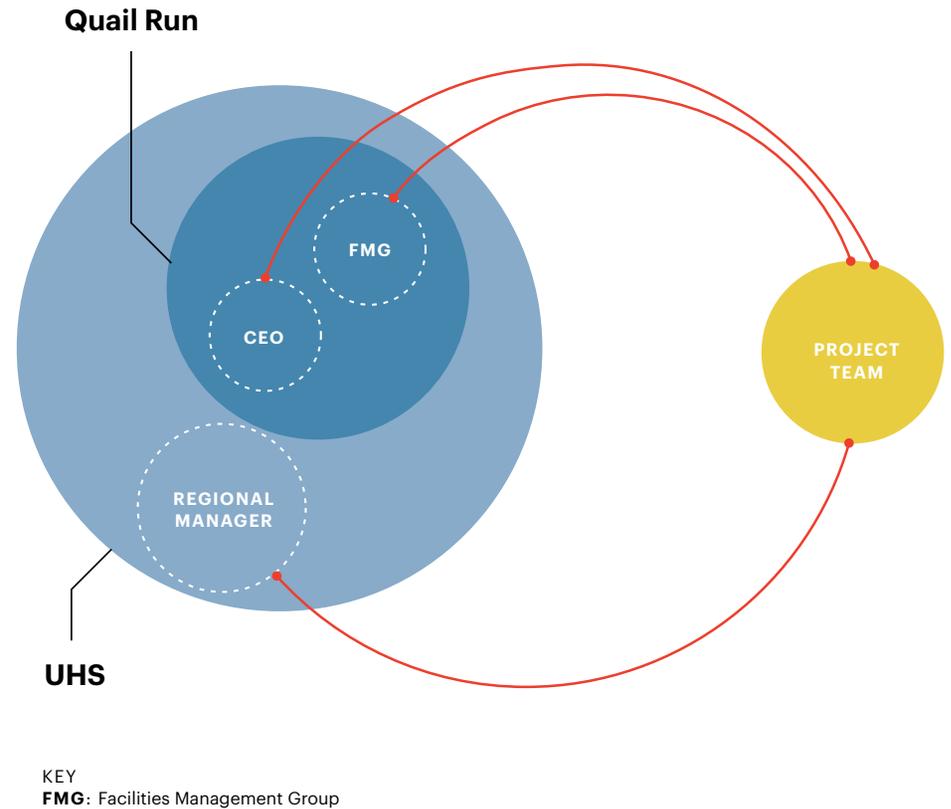
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Owner Identity & Interface

The Quail Run Behavioral Health Hospital is under the behavioral health division of UHS. The owner provides corporate support for the hospital, including design and construction, information services, clinical operations, and real estate services. The owner's regional project manager was the key owner interfacing with the rest of the project team.

The owner's project manager described the market in the area as stable and growing; their strategy in terms of growth was to respond to the community needs of northwestern Phoenix. There were many competing behavioral health providers in the area that were also expanding capacity, and UHS felt they hit a good target with the patient populations served by the Quail Run project during the first year.

When the owner first looked at properties, they targeted certain areas of the city, analyzed approximately a dozen locations, narrowed their choices, and decided on one. The decision was primarily based on speed to market: the behavioral health industry was not meeting market demand, particularly in this area of the country.



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Choosing IPD & Lean

The owner’s project manager described UHS Quail Run’s risk approach as being “as risk averse as possible.” He went on to say that risk management was a factor in selecting IPD: “Risk is discussed as a part of every project regardless of whether it is design-build, design-bid-build, or even GMP. But risk ownership is where it’s different in an IPD approach.” Furthermore, the difference in mind-set with IPD is that the team approaches all issues with the following question: What’s the best way for the project—not for my company or your company? The hospital CEO expected the benefits of IPD collaboration would allow them to reduce the final cost by \$6M compared to market.

When the Quail Run project started in 2013, UHS’s head of design and construction was a very strong Lean advocate. The owner’s project manager stated, “We were pretty much going to go down that road [of Lean and IPD], and UHS, as a whole, is continuing to do so on similar big projects—they’re all IPD. There was very little discussion other than we were using IPD and continuing to get better at it, and so that was the decision we made.” The owner’s project manager said that compared to his expectations of IPD’s value, “I got way more than I expected.”

The architect confirms UHS’s support of IPD. “Any project we’ve been involved in with UHS has been an IPD project, so it’s the way they believe in delivering projects. It’s the way we believe in delivering projects, which is how we got partnered up with them. So really, that was the main driver. We’ve been involved in IPD since some of the early Sutter projects in California and developed a relationship with UHS through those [experiences].”

The contractors considered the owner’s head of design and construction a very powerful advocate for IPD and thought that his approach permeated throughout the UHS organization. They saw UHS as a pioneer in Lean and IPD.

- UHS has pursued Lean and IPD for many years, believing it reduced their risk.
- The owner’s project manager was new to the owner group and new to IPD but understood that Lean and IPD were going to be fully adopted on this project.
- Market demand put pressure on the project to meet both cost and schedule goals.

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Team Selection

The project started with the owner, architect, and realtor creating sample layouts to compare three properties under consideration: one greenfield, one existing two-story building, and the four-story option eventually selected. The owner and architect utilized a request for proposal (RFP) process to interview and conduct a general site walk with six companies. They used Choosing by Advantages (CBA) to establish a common set of criteria, which included behavioral health experience and intangibles factors related to open-mindedness and innovation. Wespac Construction, a local Phoenix-based company, was chosen as the general contractor because they “had a better mind-set,” according to the owner. The architect recalled, “In typical interviews, you present on why you should be on the job for forty minutes, and then there is a twenty-minute Q&A. This was the reverse—present for ten minutes and then conversation for the rest of the time, so you really get to the heart of who the people are and their commitment level.”

The owner said that some of the contractors missed the mark in their response to the RFP. The owner and architect were looking for clear strategies, and some firms talked more about themselves than how they would approach the project. Additionally, the owner was looking for attitude about cost rather than specific numbers since “it was all really a crap shoot,” he said. “Because of IPD, we knew we were going to drill into the actual cost anyway.”

Wespac recalled their preparation for the interview included downloading information from the Internet on IPD, “to bone up on [IPD] and get what it was.” After Wespac was selected, they were asked to help select trade partners. Since it was a first-time experience for many of the team members, Lean and IPD experience were not criteria. One trade-partner

contractor recalled how every company sent their top personnel to early planning sessions: “I remember in the early meetings our companies all had very key players present. You had vice presidents, owners, design-team principals, business principals. There was a lot of money in those early meetings. If you weren’t committed to do it, then you wouldn’t have been a good fit for the team because they [company leadership] ultimately had to buy in on it.”

Once the owner decided on the property, the general contractor and major trades did a detailed site investigation to validate the initial cost estimates and move toward a final target cost. The owner described the discussions: “You have a ramp up of costs and then you come over the top and then the team settles on the cost to complete the project. Then you work to continually reduce costs to create the opportunity for enhanced profit.”

The trade partners said that in contrast to bringing on the IPD members, the selection process of the remaining subcontractors was much more typical. They would vet at least four, qualify them in the interview, and choose from there. Yet, the subcontractors said that because of the way they were brought on board, they understood that this project culture was different from a typical project. The subcontractors would need to work differently, including participating in pull planning. The trade partners had the latitude to offer subcontractors incentives through shared participation in the profit pool. They believed this was a helpful discussion item during on-boarding even though only one subcontractor ended up fulfilling the requirements to share in the pool.

Another factor influencing team selection was that the owner was looking ahead to their follow-up project and selecting

partners who had the capacity to work in Tucson. Even though the two projects were different in scope, the owner believed the continuity of team relationships would be beneficial.

EXPERIENCE

This was the first IPD project for the owner’s project manager. He was also new to UHS, and Quail Run was his first project with the company. The hospital CEO joined the team when the project was underway and did not have IPD experience. The owner considered the entire team to be in learning mode because the general contractor and other major partners in the agreement were new to IPD. Most of the contractors were also new to the project type and had not worked on a behavioral health facility before. The architect had a lot of experience with behavioral health facilities and said that the Quail Run project was not unique, with the exception of the conversion from an office building. Typically, behavioral health facilities are hospital renovations or ground-up constructions. The architect had done about eight other IPD projects. The owner’s project manager thought it was a positive experience to have the team going through the learning curve together. “We weren’t coming in with preconceived notions. It was very open book and we grew together in the process.”

- The architect was selected first and worked with a realtor to present the owner with feasibility studies on several properties.

- The architect and owner used Choosing by Advantages to select the general contractor.

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Developing Contract

Contract Type: ConsensusDocs 300

The team used the ConstructionDocs 300 contract. The owner’s project manager recalled that since IPD was new to most of the team, there were challenging discussions that included every company’s legal counsel to balance risk across the team. In the end, there were not many edits to the contract.

For the architect the contract was standard, since they were experienced with IPD and familiar with this owner. They recalled a number of discussions and reviews between the owner and the team to develop additional items: “The biggest challenge was developing all of the appendices for cost, and budget, and those expectations. On the projects that we’ve worked on with UHS, those [negotiations] have tended to run long. For instance, [on this project] the contract wasn’t signed until we were almost near the completion of construction.” The architect observed that the full execution of the IPD contract is always a challenge, especially with a team with no previous experience with target value design. “So there was some healthy tension leading up to committing to UHS’s budget before the project was actually showing ‘in budget.’ So there was a leap of faith from the team, that ‘Yeah, we’re reporting right now that we’re over budget, but we believe we’re going to get there. We don’t know how yet, but we’re going to do it and we’re going to sign the contract.’”

The owner’s project manager had such a positive experience with IPD on Quail Run that, given a choice, he would exclusively pursue IPD in the future. If he could do more IPD and Lean projects, he thought he “would just continue to get better on the pieces of IPD that add value to the team. Helping them understand what it means to be transparent, what it means to really look out for everybody else instead of being in

your own silo.” He also saw value in “trying to get rid of waste. The bottom line of construction is that there’s a lot of waste.”

The architect has had positive experience with IPD and said, “IPD is certainly our preferred delivery method. We’re seeing a lot of this kind of IPD-lite, or integrated design-build, or other things that don’t necessarily have the contractual arrangement set. What we’ve found in the IPD-lite-type projects is that we can still have a lot of the behaviors through design, but the value that is lost is in construction, where we’re unable to shift buckets of money from partner to partner. And so, I think that is one of the big benefits, that IPD allows you to operate as one cohesive unit that doesn’t protect individual buckets of money. You’re able to shift [funds] around.” The architect believes this fluidity benefits the team and project.

One of the trade partners said, “It sounds kind of crass, but you’re really just dropping your drawers because you’re not hiding anything. It’s all out there. And if you don’t do that, it won’t work, but if you do, it works very well.”

- Although the contract was standard, there were several stakeholders new to IPD and Lean. Discussions were extended, and the contract was not executed until construction was near completion.
- IPD is the preferred delivery method for the architect. IPD-lite can provide some benefit but the value of full IPD to shift scope and budget is key.

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Developing Parties

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- WEKIVA SPRINGS CENTER EXPANSION

Though the RFP required the general contractor to participate in the reward pool, the other firms were given a choice. The owner said, "We left it up to the individual entities if they wanted to sign [the IPD agreement]. We typically look at the project-scope size and complexity and then let the trade partners decide if they want to be a contract signer. I've done IPD with just the designer, and I've done IPD with the designer and general contractor. In this case, we ended up with seven partners." If all other partners declined to participate in the reward pool, the owner would have still used an IPD agreement with the architect and the general contractor.

Based on their past IPD experience, the architect observed that the companies with a stake in the project are good partners, and believe that the scope of work is only one consideration when deciding who to include in the pool: "The whole concept of an integrated form of agreement is to mitigate risk and spread that risk among as many partners as possible. If we're able to do that effectively with as many partners as possible, that's great. If there is someone with minimal scope, does it make sense to bring them in as a signer? Do they have a huge impact on the project? Oftentimes not. But we do look for those mind-sets that can apply across disciplines as well. There have been projects where we've had a casework guy who provided a tremendous amount of value to the drywaller just because of his mind-set about production. We really look for someone who has an open mind as well as good ideas, but also a big stake in the game."

Though they did not see it as a large problem on the Quail Run project, the architect has reservations about the designers' proportional stake in the risk/reward pool. They explained, "Once we complete design and it's 'turned over' to the

contractor, although we can work toward solutions of things that occur out in the field, our ability to affect price drastically decreases. So is there a way that the architect can guarantee a portion of that profit earlier on in the process? In other words, if we complete design and all of our estimates are coming in on budget and on schedule, is it fair for us to have a portion of our profit guaranteed to us rather than have 100% of the profit at risk until the end of the project? Our firm has thought about this because there have been several projects that have been unsuccessful from a profit standpoint. They were very successful from an owner standpoint because they came in on budget, on schedule, but we did not meet our profit goals." He observes that their firm is still committed to participating fully, "but we're finding there is really a disproportionate amount of risk to profit for the design teams in these projects."

The contractors considered the insurance and liability on the project to be pretty basic and standard. The architect explained that if the project was completed under budget, the owner has an established formula that divides the portions of the profit, up to a certain limit, between the team and the owner based on the percentage of ownership of the overall profit pool for the partners.

The extended duration of the contract discussions meant the agreement was not fully executed until construction was underway. The sprinkler trade partner commented, "One of the things that grew out of this [process] was a unique trust factor. None of us usually do anything without a signed contract. When we started this project, UHS came to us with a budget for the initial building cost, which was a tenth of what we burned through in the beginning. So it required a trust factor that [each company's costs] would be taken care of." The owner had estimated this initial cost based on similar

projects and past experiences on overall project costs, but the validation budget was spent much more quickly than expected.

- The awarded companies could choose the IPD agreement or a standard agreement.
- The architect is experienced with IPD and favors a large and diverse membership in the risk/reward pool, especially since the impact of any one company can't always be predicted.
- The relative risk and benefit to the architect is different than to other stakeholders, and the architect wondered if there is a way to achieve equity among the team.
- The contract was not executed until late in construction; the open-book sharing of financial information supported the trade partners' willingness to work without a contract.

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ST. ANTHONY HOSPITAL

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Champions

“We on-boarded all the major trades and designers very early on in the project, in the design phase,” the architect said. “As far as Lean knowledge is concerned, there wasn’t a whole lot independent from the Devenney Group [the architect] and UHS, and those two entities were really the drivers and the educators in the Lean process.” The architect did several Lean exercises, including simulations of pull planning, block towers, a work flow training called Parade of Trades, and they gave lectures on the value of reliable promises and small-batch processing. The architects said that while they were the primary driver of Lean training, “we would always have UHS along with us on those simulations, sharing their experiences and their input.”

The contractors considered the owner’s project manager to be a big advocate for IPD and Lean, even though he was new to both processes. Among the trade partners, MKB Construction (the framing trade partner) was considered to be a pioneer of collaboration from the beginning of the project: “They were the ones that really aggressively, during the first parts of construction, reiterated, ‘We can do this, we can do [that].’ And it was always a push on [helping] the budget.”

During the early planning stage, the senior estimator at Wespac, John Newman, went deep into everyone’s numbers. The team called the process of being held accountable for their costs “being Newmanned.” His supervisor from Wespac said, “He’s been doing this for a long time. He knows exactly every person’s scope. So he was out there beating them up, making sure that they were staying true to the process. He was good at it.”

The contractors thought having an architect on board who was following through with the processes was key. “The partners that [the architects] picked were excellent. I’m working on

a project right now where the structural engineer just does not work at the pace that I’m used to after working on these couple of UHS projects, and it’s killing that project. If we didn’t have the right partner to start with, this whole thing would have fallen apart.”

- The architects and the owner worked closely together to provide all on-board Lean training. The architect led simulations, exercises, and other training.
- The contractor and trade partners considered the owner to be a champion of Lean and IPD, and even though the owner’s project manager was new to both Lean and IPD, he was seen as a strong advocate.
- The contractor’s senior estimator had a detailed understanding of each partner’s budget and business plan, which was seen as an asset for keeping information clear and consistent.
- The architect was cited as a champion because of their experience and their choices of partners that supported the culture of the team.

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Decision Structure

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- QUAIL RUN BEHAVIORAL HEALTH HOSPITAL
- ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER
- ST. ANTHONY HOSPITAL
- SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)
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The owner's project manager thought that the IPD process brought everyone together to make decisions. The contractor said, "The biggest thing is not having to deal with the RFI [request for information] question. You're sitting in the room with the people. And sometimes someone else has a better idea of how to do that and make that work. They've seen it in other projects. More people making the thought processes go quicker." The architect thought IPD can support design. "You definitely have to check your ego at the door. There's going to be people giving you ideas that are out of the scope of their profession, and you've got to take those with a grain of salt, but at the same time, look at the value of what they're suggesting. If there is somebody who knows how to do that better than I do, I want them at the table telling me how to do it. So either they don't have to ask the question if they can do it that way in the field, or I don't have to do a change order because that is how they're going to do it."

One contractor gave an example of early team alignment through decision-making. "We had a challenge regarding HVAC location. We'd have a meeting with the architect, the structural engineer, the mechanical engineer, and the mechanical installer, electrical, special system, structural, and then a ten- to fifteen-minute cluster meeting. Get together, share ideas, everybody agrees. A decision was made within an hour versus four weeks of emails. That was one of the things we did early on is that we got away from the email thing—pick a phone up and call somebody."

The architect commented on the documentation of the decision-making: "We found that UHS, versus some of our other clients, are much more open to documenting decisions within conversations rather than using A3s and CBAs." While he appreciated the level of trust and acknowledges that

verbal approval was sufficient for this small, quick project, he has lingering concerns whenever formal documentation is missing because "we've all been burned on projects where [the response to] 'But you said this two months ago' [is] 'Well, where's that in writing?'"

The casework trade partner noted a turning point in the team's decision-making effectiveness when the team realized they were responsible for any changes in the project: "I think it took us a long time to realize that we were the ones that were going to make the change. Most of the time we look around to see who's going to make the change. At this job, it was us who were going to make that decision." Other contractors also highlighted accountability. "In the traditional process, there's no accountability or contract between the group of architect/engineers and their consultants and the contractor who works for an owner. In this project, that wasn't the case. We were all tied together at the hip. So if we made a bad decision, whoever made a bad decision, it would have an impact. But it also meant decisions did not rely on one person—a team of ten people was helping you make the decision."

The owner's project manager also thinks there is better coordination on IPD than on a typical job: "On a typical job, everybody's in it for themselves. Here, you have to take care of the other companies and make sure they're doing their job because it affects your bottom line also—and that's big." The hospital CEO felt the process was relatively smooth. "Even my joining late, it was clearly a participatory process with all the vendors. I thought it was fairly easy in terms of moving the project along and making changes midstream and so forth."

The team recounted a crucial moment that solidified their collaboration and clarified their investment in Lean processes. At the beginning of the project, the architects suggested a

third-party Lean planning tool they had found effective. The tool had a free trial period but commitment for the duration would be a significant financial investment (\$50,000) for the team. The architects were pushing for the team to adopt the tool, but other team members were skeptical of its value compared to the dashboard and other tools already in place. One trade partner recalled that working through the decision "was a watershed moment because it was within the first two months of working together. And that's when we came together as a team and said, 'No.'" The trade partner described how, as a result, the decision hierarchy shifted away from the typical relationship of the architect or owner dictating decisions to one in which decisions were made collaboratively.

- Decision-making improved when the team took ownership of decisions.
- The architect welcomed voices at the table that might know more than they did.
- The contractor noted that the trade partners' understanding of the architect's work was very valuable, and something that rarely happened outside of IPD settings.
- Several team members noted the speed to resolve issues was much faster on an IPD/Lean team than on traditional teams.
- The architect was aware of the need for speed and also protection from future issues.

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On Board & Off Board

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The owner's project manager said there were very firm conversations around off-boarding. "In fact, the architect's project manager was switched out because they just weren't doing what we needed them to do and being as participatory as we needed them to be. [He was] making some assumptions without discussing with the rest of the team, so we voted him off the island, and the architect brought in a replacement." The owner's project manager considered the off-boarding process to be straightforward: "We laid out ground rules at the beginning. If something was going to be advantageous or disadvantageous, we needed to be open and honest about it with each other and as soon as possible. Not belabor the point until we get too far down the road to be unable to recover." In the case of the architect's project manager, we "talked with him specifically and said, 'Here are some opportunities, this is what we see'...[but things] didn't change."

The owner's project manager said the issues with the architect's project manager appeared in two areas: his estimate for the architect's time devoted to construction administration and to the development of BIM. Frustrations around the construction administration time centered around lack of transparency and a lack of flexibility in accounting for the tasks and time. In terms of the development of BIM, the architect's project manager presented a package, which seemed out of scale with the project need. As the owner's project manager described, "Okay, that's great, it's beautiful, love it, but we're not going to spend \$1 million on BIM. We're going to look at where it makes sense to use BIM." The owner believed the architect's project manager was motivated to "keep as much BIM as possible because it utilized his staff. On a typical project, this is what you would propose. On an IPD [and Lean] project, you're getting into the weeds of all that stuff to try to figure out whether it brings value. If it does not

make sense, you're not getting enough value, then you go in another direction or chop it down to what does make sense."

Other than the architect's original project manager, the team did not see the need to off-board anyone else. The general contractor observed that the team was composed of collaborative players and the Lean processes really helped achieve good balance: "We were very selective about who we picked to make sure that they were fully qualified to pull this off."

The architect explained that everyone went through the same on-boarding process, regardless of when they joined the project. The training covered "Why Lean? What are the tools we're using?" The architect noted that during the half-day session, "we would sit down with new folks and tell them, 'This is what we're doing. This is why we're doing it, and these are the metrics that we hope to achieve.' Sharing the conditions of satisfaction for the project with them." The contractors reacted positively to the on-boarding process. "It helped at the beginning of one of these projects to have the owner's project manager come in, with all the key foremen in there, with a good PowerPoint, and to walk through why UHS does this. That helped out a lot. It really opened some of the guys' eyes."

The owner's project manager felt that it was beneficial for the general contractor and trade partner superintendents to remain the same throughout the project. "We didn't have a major trade partner superintendent bail and go to another project midstream. It would have meant training somebody else, and we didn't have to do that. I think [the superintendents] got really good at understanding, 'I got this' or 'he's got that' and how they work together."

- The off-boarding process was fully developed and planned. The only time it was used was to remove the architect's project manager.
- The on-boarding process involved a half day session led by the architect and was consistent for all members of the team.

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Clarity of Goals

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The owner said their biggest goal was the cost, then the schedule: “From a cost perspective, we knew where we needed to land. Once we got full funding corporately, we didn’t want to have to go back to the well for more. In fact, the total overall project budget, including land, building, and everything else, was \$22.5M. We started as a team at \$26M. That’s when we first got all the players in here, and everybody started looking at their scopes. We landed somewhere around \$20M [with total final cost of \$22.5M].” The owner said there were other, smaller goals, such as saving all of the trees on the site, but those items were a subgroup of cost and schedule.

The hospital CEO had a slightly different perspective and believed the primary driver on the project was speed to market: “We looked at the fact that there was already a core and shell of a building and asked how much we would have to do to it to get it ready to inhabit or to get a certificate of occupancy. We thought we’d save the dollars there. As we got further into it though, we realized that we needed to really upgrade everything—the entire electrical and mechanical systems, the plumbing systems were all a mess. But we had set aside enough money in the overall project budget to do some very unique things in the facility.” He also highlighted, “There were a lot of decisions made just based on patient safety. We had some contractors who were familiar with behavioral health and hospitals; others who were familiar with health care but not behavioral health specifically. So we re-evaluated some of those decisions as time went, and we re-evaluated some of the equipment that was chosen, asking, ‘Is this the best piece based on the level of risk we are willing to take?’”

The hospital CEO discussed the goal of staffing effectiveness. “Your highest cost in most hospitals, and particularly

behavioral health, is your staff. You’re not doing high-volume tests; you’re not doing a lot of types of things that require very expensive equipment. So in terms of the design, in terms of what we considered at the nurses’ station, for the layout of the rooms, and for all the flow and all that stuff were certainly centered around how to use the staff most effectively, which then again ties back to patient safety. How do you visualize the entire space? How do you make the space so that patients move around in a way so that you can see them and manage them appropriately?”

The architect, who has worked with UHS on a few projects, said they are always budget conscious and have very aggressive goals. On the Quail Run project, the architect thought the team did as much as they could to reach their goals. Because the owner had completed a number of similar facilities across the country, they have established standards for the quality of materials and finishes, etc., which the architect believed helped to set expectations.

The trade partners thought the owner’s goals were clearly expressed and actionable and understood that schedule and cost were major factors for why the owner elected to use IPD on the project. They also appreciated the impact the patient safety goals had on the project as a whole, including several details developed to address safety.

- The UHS owner prioritized the cost over the schedule, whereas the hospital CEO prioritized the schedule since their timeline included readying a fully functioning hospital staff to coincide with the building completion.
- Patient safety was a major goal; this was particularly challenging with a multistory building type.

RFP CRITERIA FOR GENERAL CONTRACTORS:

- Integrated Lean Project Delivery (ILPD) experience (Phoenix or other locations)
- ConsensusDocs 300 (or similar relational contracts) experience
- Behavioral health hospital experience (Phoenix or other locations)
- UHS healthcare experience (or other for-profit hospital systems)
- BIM capabilities and other collaboration platform experience
- Phoenix Trade Partner relationships with similar ILPD experience
- Target value design cost estimating experience
- Pull planning experience utilizing the Last Planner System (LPS)
- Set-based design and construction solutions

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Resources & Facilitation

The contractors thought that the Lean project delivery helped them be successful as a team working together for the first time. The IT contractor said, “We had all seen it, you read about it, but it was the first time we had the opportunity to be brought into it.” The architect said Lean and IPD were relatively new to the majority of the team, but they were all very open to new ideas and were accepting of it, although there was a learning curve.

The owner’s project manager said they brought in full-time Lean coaches to go beyond “pull planning and scheduling”: “We brought in a coach to teach this team how to [use Lean], how to look at a milestone. What’s the definition of a milestone? How do you go from milestone scheduling to six-week look-aheads and then to weekly work plans? How do you integrate all that stuff? How do you look at the various swim lanes of the different trades, and how are they integrating and how are they able to look ahead? We had to train the guys quickly on how to do that. They got better at it on the second project because they’d been doing it for a year and a half. But there’s always room to learn.”

They also brought in a coach to look at personalities, using the analysis tools StrengthsFinder and Core Clarity to get to know more about each individual on the team and to improve collaboration. They started primarily with the project management group but also included the major trade superintendents. Once the coach reviewed the Core Clarity protocols and individual strengths were determined, the next step, as the owner’s project manager stated, was to ask, “What does that mean now, and how do we use that data as a team and to know our strengths and weaknesses?” The team changed who would lead the Big Room every other week. The owner’s project manager commented on the wide range of

styles this rotation revealed, and how over time the team got to understand each other’s personalities better. The owner’s project manager said the Big Room developed a comfort level among team members: “It was very engaging and we got into each other’s business.”

The trade contractors also believed the Lean training helped support a strong group dynamic. They were particularly interested in the StrengthsFinder exercise. The woodwork contractor noticed, “It brought out how you work with different [personalities] and explained, maybe, that we have to go through [a different] process to get through to another type of person.” The MKB contractor said, “I think the very first one [training] relaxes you; it gives you more confidence.”

- UHS brought in outside coaches to focus on Lean tools and processes, such as pull planning and scheduling, and a coach to support Core Clarity and StrengthsFinder.
- The trade contractors concurred that the Lean training was helpful and were intrigued by the self-assessment tools.

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Tools & Processes

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The owner has standards and templates for Lean tools that they use on projects, which the owner directed the team to use, bringing the value of those Lean tools to each project. The team held weekly budget-update sessions, characterized by one trade partner as long and tedious, who admitted that “it really did help out, so we could really see how we’re tracking as a team and if we’re going to actually meet our end goal.”

The architect indicated that visual management, including the constant review of the design and construction teams’ rates and fees, was a huge part of encouraging fiscal transparency and willingness to move money from one bucket to another. The conditions of satisfaction were put on a poster and displayed in the Big Room and in the construction trailer. The architect said, “Those conditions were established once all the signatories were brought on board, so they had some involvement and buy-in. We would point to it on different occasions and ask, ‘Are we meeting these still? Don’t forget. These are still our goals.’” Conditions of satisfaction were also a part of the project dashboards, referenced weekly. Unfortunately, the dashboards were not effective and their use dropped off. The trade partners believed the dashboards fell out of use because it was not clear who would lead the effort.

The team used scheduling breakdowns ranging from sixty- and ninety-day milestones, six-week look-ahead schedules, and weekly work plans. They tracked percent plan complete (PPC) and averaged around 85%, which the owner thought was great for this team. They started at 60% and went to 120%. The owner noted the wide swings were due to the team’s inexperience: “We didn’t really understand what sandbagging

meant and how to properly line up the resources [manpower and supplies] to efficiently execute the work.”

The owner’s project manager said that at the beginning of the project, they did not know much about target value design, but by the time the project was complete, three years later, he approached target value design completely differently. He described when they first began: “We pretty much just tried to maximize the number of beds, maintain the site for staffing, etc., but that was as far as we went with target value design.” To manage costs, the owner’s project manager detailed a process that was not traditional value engineering: “We really would get into a specific system—we’ve got these big enclosures up on the roof—is that where we’re going to put our HVAC system? Does it still make sense to use that same layout? How are we using the steel structure that’s here?”

The team used this type of process to manage budget around several issues, including fireproofing, nurse-station layout, and minimizing the space deliveries would take up. The owner’s project manager said, “We tried to work with the team. In execution, it didn’t happen as well as we had hoped, but we definitely did think about it. It’s completely different [than] value engineering. We got it right on some and missed the mark on others.” The architect said, “The items that were to be installed were reviewed as a team during design, so that when it came time to install them, it took on much more of a target value design mentality than value engineering.” The IT trade contractor commented on what he saw as the greatest success: “We were able, as a management group on the higher level, to work through the budgets, and we were able to pass that down to the field staff and get them to buy in on it.”

The team utilized Last Planner System: “The team adopted, for the first several months all the way through design, vPlanner, which is a very visual planning system that has a lot of power behind last-responsible-moment dates, rapid replanning efforts, and things like that.” During construction the architect moved away from vPlanner because they had primarily been the ones leading that effort, and the team believed the cost to purchase the software was not a good investment. “The constructors in the team had their own system with Excel and keeping sticky notes in the trailer. Weekly work plans developed that way, with a much more a manual rather than automatic software solution.” The owner’s project manager concurred that pull planning worked well with both the automated and manual systems but supported the team’s decision to opt for the manual systems during construction.

The architect established dashboards and metrics for burn-rate management, allowing them to easily track burn rate, based not only on what time is being spent but also on looking at what time was estimated and what is getting done. “If we burn 50% of the budget, are we really 50% complete with the design? If we’re behind, what does that mean? Or if we’re ahead, is there opportunity to actually give money back? Or move to another bucket?”

- UHS standards and templates for Lean tools were helpful to the team.
- Weekly budget meetings were time consuming but very valuable.
- Visual management material posted in the Big Room was referenced frequently.

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Lean Effectiveness

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ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

The architect said that in their culture of design, they always believe in a set-based design philosophy and the development of multiple solutions, a part of which would be “looking at four or five different sites for the project, and once one of those was selected, determining the best layout for the building.” In the case of Quail Run, “being more of a fit-out, there wasn’t as much opportunity for architectural exploration, from a set-based design aspect, because UHS has somewhat templated rooms and such.”

The team did a number of first-run studies. They set up several video cameras to evaluate specific tasks that were likely to recur frequently, for example, building an interior wall. Analysis of the video could reveal actions that could eliminate wasted time and effort.

The team used a lot of A3s and performed two or three CBAs to look at different systems and strategies to attack issues. The electrical contractor said, “It was a hassle doing it, but when we had a question and all the answers there, we went around the table and made the best decision we could, and went forth with it.” The team used Plus/Deltas and Last Planner frequently. The contractor found Plus/Deltas particularly valuable in making meetings more effective—“because more time spent is just time lost.” The architect noted that the team improved their use of Plus/Deltas by creating lists of action items with assigned leads to be resolved before the subsequent meeting.

The trade partners found that pull planning was very effective in allowing them to work together. The contractor agreed that the team’s successful coordination was primarily due to pull planning. “I wonder why we haven’t done this on more projects. At weekly meetings, you have to have everybody

there at the same time and it’s a real pain, but for that time you spend up front, it really pays off in not having to do things over again on the job. I like that.”

The team employed plan-do-check-act by solving shortcomings on one floor and then adjusting for the next floor.

- Set-based design is incorporated into the regular practice of the architect and was used effectively on this project.
- Video studies were used to increase efficiency in construction tasks.
- A3 and Plus/Delta were used frequently; plan-do-check-act was used on each floor to help plan for the next floor; and pull planning was a productive process.

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AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION

AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE

MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

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BIM

The architect said that based on the previous projects they had done with UHS and other clients, they initially started with an extensive BIM-implementation plan. The first priced cost to produce a full BIM was about \$1M. The owner questioned this amount, asking the team to look at where using BIM would make the most sense for the project: “We hammered that pretty hard because the program came in so big originally. We pretty much shoved it down to about \$100,000 worth of work, about 10%.” Quail Run had fairly generous floor-to-floor heights, and MEP systems were relatively straightforward, so coordination was not as critical as in acute-care program types. The architect believes that “there’s value in BIM coordination sessions. Without them, it translates into rework in the field. But [in this case] because it wasn’t acute care, the rework was relatively minimal.” The architect did not get into the detail of modeling-stud placement but modeled up to the detail of wall heights. They shared their model with MEP designers for clash avoidance rather than full-scale clash-detection analysis.

The owner’s project manager thought that using BIM for clash detection was a benefit because a lot of the partners were already designing in Revit. They were “working the model behind the scenes. We just didn’t have a full-blown [coordinated model] like you would on a major project.”

The mechanical contractor used BIM on the project, as they typically do, to prefabricate the sheet metal. The fire protection contractors also used BIM. The electrical contractor (Bruce, DP Electric) said that by the time they were ready to use BIM on the project, it was too late: “We already had our pallets on the floor. So construction was pushing design very heavily throughout the whole project.”

The special systems contractor (Harold, Southwest Integrated Solutions) said, “The Lean process actually worked against BIM because BIM is a way of coordinating what’s going on, but we were already meeting weekly, if not daily. There were phone calls, and the communication was there. We weren’t waiting on a design drawing coming from some faraway place. It was a daily decision.”

- The architect originally proposed an extensive BIM, but the owner felt strongly that the needs for the project were minimal.
- Some clash-avoidance work was coordinated with models since many of the partners were using the same software platform.
- One trade partner commented that the Lean processes provided so much coordination that BIM was not really needed for that role.

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Workplace

According to the architect, because they had the most experience with Lean projects, they led most of the Big Room sessions at the beginning, setting up agendas and meetings and going through each part of the design. They said that during design, the team met at their office and never fully co-located during design. The trade partners found that meeting at the architect’s office was difficult because the meeting started at 8:00 a.m. in downtown Phoenix, and it was difficult to get there with traffic. For different portions of the work, the architect would meet with different partners, who would bring their computers to the architect’s office and design with the architects. The architect noted, “All the partners here were local, which was nice. A ten-minute drive away, so we were able to get a high level of coordination without a true co-location. Whereas we found co-location definitely beneficial on other projects, it wasn’t as important on this one. Once construction started, the Big Room shifted out to a shell space that was set up in the actual building, where the weekly meetings were held, until it was moved to the construction trailer once that space was required.”

A trade partner described the moment they realized how much the collective meetings cost the project: “That was an eye-opening experience. We got those first invoices. We realized what people were charging. We thought, wait a minute, there’s more efficient ways to do this.” The owner’s project manager understood that the Big Room experience was new to most of the partners, and it took them a while to see their value: “Most of these partners were not used to being on-site every other week.” The team had a projector in the Big Room, and according to the trade partners, the architect would sometimes “be designing something while we’re just sitting there all watching and making sure we all agreed with it.”

The team used GoToMeeting every week for their bigger meetings and their cluster meetings. They utilized screen sharing and thought it was very effective. Southwest Integrated Solutions, a contractor who had never used GoToMeeting before, thought it was “huge” and “just saved so much,” and after the project bought it for his company.

- **Most of the partners’ offices were close to each other so the team did not feel a strong need for co-location during design. Virtual meetings with screen sharing was very effective.**
- **During construction, a shell space in the existing building was set up as the Big Room.**
- **Members of the team new to IPD were surprised by the amount of billable time consumed by the early planning meetings.**

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Team Alignment

The contractors understood that the IPD contract was different from a traditional contract because they had a target number they were trying to stay below, which was tied to their profit pool. A trade partner commented, “We weren’t trying to meet our own numbers. It was one big pool. We’re all watching out for each other. We’re not trying to stash money for profit. Everything was very well structured and laid out. We knew what we were going to make at the end of the job if we met our goals. It was pretty straightforward.”

The architect said the contract’s outlining of the sharing and enhancing of the overall profit was an obvious driver. “Conversely, the threat of ‘If this project goes over budget, it is going to come out of everybody’s profit’ versus just one partner’s, was also an incentive. It drives teams to perform better.”

The electrical contractor discussed another aspect of trust within the team. “Numbers are the big thing. In past experiences...the numbers that we expose are from one trade to the general contractor, and it’s usually kept somewhat in confidence between those two. Now, I see all his [other trade partners’] numbers—I see his labor rates, how many man-hours he’s budgeting. Exposing those things and learning to trust one another, what we’re putting out there, that was kind of a big step.”

The electrician trade partner also noted the need for companywide support, saying, “I had to convince the president that it was working and that there was trust there. My foreman, who was kind of a gruff one and didn’t really want to conform, once he got into it, he was one of the lead people in this.” The trade partners commented that the financial incentives positively impact the fieldworkers to collaborate. The electrician noted the motivation of making

sure they understood that their company had a financial incentive to complete their work within the planned budget—plus, pull planning, “really helped them understand exactly what needs to happen before they can do their work, which is really huge.” The framing contractor regularly reminded his superintendent about IPD risk/reward: “When I ask for manpower, they had to answer because we needed to get this job done.”

The framing trade partner appreciated working directly with the architect. He found it helpful that he could offer his “ideas [about] how to build the job without the standard spec details” and how to speed up his work. As he described, “[I was] communicating with the architect throughout the construction, and even told him, ‘This is way overthought. Instead of doing that, can we do this?’” The general contractor saw great value in trade partners knowing more about the architect’s work. He believes general contractors have a good appreciation of the architect because they “always work hand in hand with architects,” but if trade partners did too, “it would make things so much more efficient...These guys that hardly ever see what actually takes place [in the design process]. I think it was a big eye opener.”

The owner’s project manager also said, “IPD is great because you get the end user involved in the design. At the same time, you get the builders involved at the design level because they understand what you want and can ask, ‘The impact to build that for you is that it’s either going to [affect] cost or schedule. Is that worth what you’re looking for financially?’ If it is, and it works, great, you move forward with that idea.” He concluded that there needs to be give-and-take between the urgency of need and the budget capacity.

- The trade partners saw a significant difference from traditional delivery because of the shared profit pool and its relationship to the target cost.
- Shared management of the risk pool helped the team align.

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Collaboration

The hospital CEO said the team spent three to four months during early planning detailing the scope of each trade partner and identified clearly defining roles, responsibilities, and risks. After these discussions, the team coordinated scopes of work between trades. There were several examples of efficiencies gained by integrating scope. For example, the team assigned the renting of a lift to the electrical partner and eventually decided that all group rentals would go through that partner. The architect noted this as unusual: “The rentals going through our electrical trade was a big thing, as most of the trades typically will not agree to that. They want all their ladders, and lifts, and everything on their own because of liability. But the team was able to put together some documents to protect themselves, and agreed.” Another example was that the team had not anticipated the need for fire caulking, which was part of a new code. Each relevant trade priced caulking for their work, but a better alternative was for one company to do the caulking for all the trades. The owner noted that these efforts saved both money and time. He attributed these benefits to candor and collaboration: “That is very unique to an IPD environment. Holding each other accountable in their scopes really caused everyone to open up their books and really talking through costs and savings legitimately and not just fluff it up or sandbag.”

The owner’s project manager felt he did not have to drill into the team’s numbers as much as on typical projects because they were doing it among themselves or with the preconstruction director for the general contractor. The owner observed the cross-team exchanges were very productive.

Patient safety was a prominent concern since a patient’s behavioral disorders could result in attempts at self-harm or broken windows. There were risks posed by the floor-to-ceiling glass of the existing building and for several months

the team struggled with how to secure the windows. After exploring multiple options, the casework trade partner proposed the solution of blast-resistant film. This was a good solution but, “everything is a chain reaction,” the electrical contractor said. The film changed the glass opacity, which “drastically affected the load calculations we had for all the HVAC systems. That was huge. Until we finalized what film we were going to use on the inside and the outside, every time it would change, we’d have to do a whole load calculation—that takes a couple weeks.” Fortunately, as one trade partner noted, time to resolve this did not negatively impact the overall schedule. He praised the team’s ability to manage their work with Lean processes: “In a traditional construction project, that [study] would have stopped everything. We would have all been waiting around for answers. We would have had to have direction before you could price, before you could build, before any of us could do anything. But here, we were able to work with that. It was an important issue, but we were able to run multiple processes. It did have a minor impact on schedule, but didn’t stop the project.”

Use of prefabrication for bathrooms was another lengthy decision process to study how to get units into the building and determine costs. After discussion, the contractors felt site-building bathrooms was the right decision. The decision rationale and justification were documented using an A3.

The trade partners, in keeping with IPD and Lean processes, were involved from the early stages of design. The architect noted that while there are great benefits to this, there are also accompanying challenges. There was tension regarding the amount of time the architects took to complete the design and to produce the full documentation set. One trade partner expressed, “I didn’t know what it involved to get through the whole drawing process, but every meeting we’d ask, ‘Okay,

why is it taking so long? You see it up on the pull plan board. Why can’t we get this done in a couple of weeks?’” The architect replied, “The challenges we had through decision-making was that most of the constructor partners thought that we were further along in design and didn’t understand that we were inviting them to the very beginning [of the design of the building] so that we could develop that together. So there was a lot of education that happened at first to understand that...Initially, it was difficult to build that trust but [it improved] once they understood where we were in design.” The architect concluded, “The design was resolved and the team achieved their goals.”

- The team invested time to understand the scope of each partner in detail.
- There were numerous examples of scope trading that saved time or money.
- The owner noted the candor of the IPD team members talking about scope and costs “legitimately,” without sandbagging or fluff.
- The team believed that the profit incentive gave them leverage to advocate within their companies for the necessary resources.
- Lean parallel processes ensured that the project could continue in spite of a lengthy problem-solving process around patient safety.

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Team Culture

The trade partners concurred that early on, there was a lot of uncertainty about the risks related to the project type and the existing building. They were unsure how a behavioral health facility in a multistory glass building would be affected by fire-code compliance and other coordination issues. The fire-safety trade partner recalled the challenge of pushing the limits of the permit process: “We were building right up to the red line of the permit process, not because the design team wasn’t getting it done but because Phoenix was dragging their feet with so many things.” The architect believed the project complexity was largely driven by the change in occupancy from office building to hospital, which caused several schedule and coordination issues throughout the process.

The team participated in activities together, such as going to spring training games in Phoenix, golf outings, etc., to get to know each other. The architect said, “We found that once you’re able to open those lines of communication, that everything just flows that much better. I think the team certainly gelled as the process went through.”

This team continued on to another project in Tucson. “It was an addition to an existing facility rather than a retrofit of an office,” said the architect, “but the same teammates. The idea was ‘Let’s apply all the lessons learned. Let’s build on the trust that we already have to make the next one go that much better.’ I don’t think that can be overstated, the importance of trust and even just having fun among the team.”

- The team socialized outside of the project setting and found this helped to open the lines of communication so that “everything just flows.” Trust and fun were considered to be of paramount importance.
- Most of the team continued on to a second project and appreciated the opportunity to apply their lessons learned from this project.

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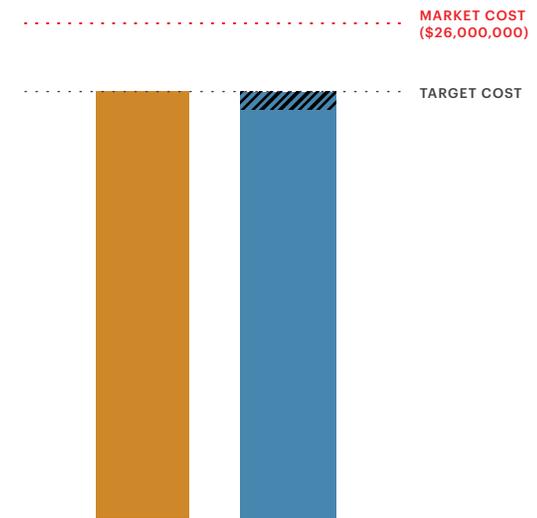
Profit & Payout

The architect said the general contractor “was very good and very proactive in their live estimates, and they were able to give us very detailed budget information as we progressed through the design.”

The general contractor, in turn, stated that the team successfully tracked schedule milestones and costs, and were very proud at the end of the project of how much they actually saved. They thought the profit pool was a good incentive, and they conducted weekly budget adjustments to figure out what their incentive was going to be at the very end.

The contractors said that at the onset the funding limit was about \$22.5M. The first time they put together the numbers, it was around \$26M. They landed at around \$20M, and from there, the construction number went from \$20M down to about \$16M. The overall final cost of the project was \$22.5M, including land, and the construction cost ended at approximately \$16.5M. The team realized about \$3.5M in savings from the team’s original construction estimate.

- The team achieved significant project savings.
- The contractor was able to provide timely updates on the project budget.



Allowable Cost	N/A
Target Cost	\$22,507,640 (100%)
Final Cost	\$22,542,007 (100.15%)
Target Profit	N/A
Final Profit	\$856,550 (3.8% of Final Cost)

QUAIL RUN PROJECT COSTS AND PROFIT

The final project cost of \$22.5M was approximately \$34,000 more than the target cost. The profit payout was approximately \$856,000, almost 4% of the final project cost. Allowable costs for construction were set as \$15,136,367, not including the real estate.

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Budget & Schedule

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The owner's project manager said the team's work to reach the financial target exceeded his expectations, although it took some time for the team to get used to how to invoice. "How do you correctly manage the dollars between the different buckets and then in the profit pool? If there's a change, who's responsible for the change? Which pot does the money come from to pay for that change? It took us some time to get those figured out, but at the end of the day, financially, we did really well. The team made about 17% enhanced profit, so that was great. They'd never had that before."

The owner's project manager was less satisfied with the schedule target. He believed the team did not fully understand what was needed to get a city permit or how to get validation and licensure at the end of the project. "I pressed the team. I wanted them to walk through step by step what it's going to take, what desk it's going to sit on, what's in the package, how long it's going to take." He acknowledged that integrating the city process to the schedule created "a schedule mess." He stressed to the team that there were ramifications for the hospital CEO if the promised completion date was changed: "Even though it's six months from now, [the CEO has] got to [project] revenue. He's got to start thinking about hiring." They obtained a permit for the core, a second for demolition, and third the construction permit. The owner's project manager said that they took some risks and went ahead and started: "In the state of Arizona, you can start [before fully permitted]—a lot of states do that—but if you go too far down the road and the inspectors come and say, 'Well, that's not up to snuff, you've got to fix that,' then that's the risk we've taken as a team."

The hospital CEO thought that, financially, the project went really well, as they ended up being able to add value to

the project, "which was awesome." On the other hand, he considered the schedule to be a struggle: "We were late, but some of those struggles were self-imposed, others were because we couldn't control when the state could come out to do the inspection to give us the permit. We had to wait almost two months to get a permit. Then at the end, getting the certification done was another challenge." The contractor, likewise, thought they did well as a team on cost management. "We saved quite a bit of money. We're a little over schedule, that was a bummer."

Coming into the project, the owner knew the HVAC and electrical systems were going to be a challenge, so they set aside contingency funds. In the end, the cost was higher than anticipated. The owner said, "Did we know it was going to be that bad? No, but we were able to adjust and move some things around to make it work."

Even though completion missed the scheduled date by about sixty days due to factors both from within and beyond the control of the team, UHS considered the schedule as being met because the team was new to UHS and IPD, and they proactively worked throughout the project to find ways to save time. The architect thought team effectiveness was measured by PPC but also "just by the fact that the team was able to achieve [close to] the very aggressive schedule that UHS set forward. Based on an industry standard of what the schedule typically would be and what was achieved, the delta in between speaks to the effectiveness of the team." The architect, furthermore, thought the team met and exceeded the owner's objectives: "Quail Run was a real success as far as schedule and budget was concerned. There wasn't any compromise in design, or quality of materials, or anything like that, throughout the process."

The trade partners agreed that they underestimated the management team's time but were able to compensate by redistributing other aspects of the team's time. The partners observed, "The management team invested in the details of the project, so you're able to take money in other [areas of the budget] to cover that extra cost [for them to engage]."

The architect's original project manager created some challenges for the team because of his attitude toward budgeting hours for designers and technical staff. When that project manager was replaced, the architect's time was more aligned with team expectations. Based on past experience, the architects typically front-end load staff on projects. They thought their budgeted hours on the project were sufficient to complete all the tasks on time. "We understand the meetings that are going to be required. On our early projects we certainly didn't and we missed the boat on some of those, but this one I think we hit pretty well. It wasn't a huge project. It wasn't overly complex, so it was pretty straightforward for the most part from a delivery standpoint."

- The owner believes the team exceeded expectations in managing the target cost.
- The owner added scope to the project with the financial saving achieved by the team.
- The team was less successful meeting schedule goals, mostly due delays from the city.
- The team effectively managed their own time.

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Building Outcomes

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The owner's project manager was pleased the team managed the budget well because "we were able to put in a lot of extra things." For example, the room where the interview was taking place was planned to be a "shell space. We were able to finish this space out with flooring, ceiling, finished walls, tables, and chairs. All the extra stuff was not in the original plan. We were able to get this finished out as a beautiful training room."

One of the owner's goals was a GPS locating system for the staff. "One of the reasons we did this here, in particular, is because we were starting with the infrastructure from scratch. The fact that it is a four-story building is somewhat uncommon in most behavioral health settings. Normally, they're single-story buildings; they're laid out in pods. We knew one of the difficulties was going to be tracking staff and patients throughout the building."

The hospital CEO said their facilities do not typically have Wi-Fi, like at Quail Run. "This facility is kind of the top of the best facilities we have in the company as far as technology is concerned. Because we'd saved enough money here or enough time there, there were some opportunities to pay for some extras, some wants, that were not absolute needs. We were able to get those into the budget. We also made sure the long lead items could be identified and then easily obtained as much locally as possible."

The hospital CEO and director of operations believed there were things they would have changed if they had been more involved at the beginning and the infrastructure needed a bit more detail than it had. For example, they would have included more control valves and more ways of finding them, since they might have a seriously impact on the building eventually.

PROGRAM/TENANT SATISFACTION

The owner's project manager said it was critically important to have the voice of the hospital leadership on the project team. There were several times when the hospital CEO was able to advise the team based on his forty years of experience with this type of facility. "That's what's unique about IPD: you bring as many of those voices and knowledge to the table as early as possible. By the time you get to the end, you don't have questions. It's very clear." Although the owner saw the benefit to having hospital leadership involved, at the early stages of this project the key positions of hospital CEO and director of operations were not filled. The team had to make assumptions on what the hospital wanted. The owner's project manager said, "We didn't have an end-user voice early on in our decisions. Once these guys were on board, it was really great because we could go right to them and [ask questions]. Being a brand new facility, it's challenging to get answers to a lot of those questions. If you're just adding to an existing facility, you already have the meat and potatoes of the facility. It's a different animal than starting from scratch, like we did at Quail Run."

The owner's project manager conducted a retrospective review with staff after the building was occupied. He spent time as they were ramping up to ask them if they knew why things were designed a certain way and if they knew how the systems were supposed to help them work as technicians. "We spent an hour or so walking the floor and talking about different elements and strategies. Now, in an existing facility, you could bring them in during design, which works really well. In this case, we didn't have that ability, because we were just getting started in a new facility."

The owner's project manager was on the project full time, as were the hospital CEO and director of operations after they were hired, who were also starting to develop the operations for the new hospital. The project manager worked primarily on the construction aspect; the director of operations and hospital resources focused on the building systems and their maintenance needs. With speed to market as a major criterion for success, the director of operations was already considering the hospital populations, including the staff, during construction: "You're bringing the staff in. This is a new construction, new project, so everybody will have to be hired. You have to figure out the menus. You have to figure out the staff schedules and the shifts and the timing. There are three different populations [of patients: geriatric, adult, and adolescent]. Those relationships, by floor, had to be figured out." He acknowledged his planning was incomplete and "even after I've been off the project, they are still finding better ways to do and execute or use the hospital." The hospital CEO thought IPD made discussing changes and looking at patient-safety options a little easier because it required that everybody be in the room. He also thought that better decisions were made because everybody was included and could bring up issues that would affect their work.

- Key hospital staff was not hired until the project was underway.
- The owner was pleased to be able to add scope to the project with the savings the team achieved.

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Project Credits

PROJECT TEAM

Signatory & Risk/Reward Pool

Universal Health Services (UHS) Quail Run, Owner
 Devenney Group Architects, Architect
 Wespac Construction, Contractor
 Walters and Wolf, Trade Partner/Constructor
 MKB Construction, Trade Partner/Constructor
 D.P. Electric, Trade Partner/Constructor
 HACI Mechanical Contractors, Trade Partner/Constructor

INTERVIEWEES

Owner (UHS)

Dennis Barry (Director of Plant Operations), Dave Carnahan (CEO), Kent Hedges (Project Manager)

Architect (Devenney Group Architects)

Scott Rasmussen (Project Architect), Eric Ubersax (Lean Coach/Director)

Contractor

Kirk Jonovich, Wespac Construction

Trade Partners

Harold Ammons, Southwest Integrated Solutions; Kevin Hanak, Walters & Wolf; Bruce Meyers, D.P. Electric; Michael Moore, HACI Mechanical; Fernando Sandez, MKB Construction

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WEKIVA SPRINGS CENTER EXPANSION

Project Description

PROJECT	Rocky Mountain Institute Innovation Center
LOCATION	Basalt, CO
BUILDING TYPE	Office
PROJECT TYPE	New Construction
CONTRACT	Custom
OWNER	Rocky Mountain Institute
ARCHITECT	ZGF Architects
CONTRACTOR	JE Dunn Construction
PROJECT START	January 2013
COMPLETION	November 2015

Project Images

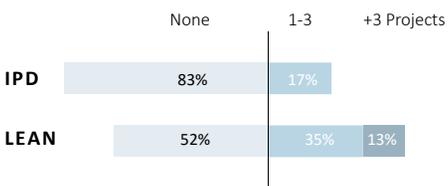


Photo Credit: Betsy After, provided courtesy of ZGF



Photo Credit: Tim Griffith, provided courtesy of ZGF

Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 24

For the majority of the team, this was their first IPD project, with few members having experience with one to three IPD projects. Approximately half of the team had some prior experience, and a few members deep experience with Lean. For a majority of team members, this was their first project working together and with the owner, though a few team members had worked together or with the owner on several previous projects.

Building Size 15,610 sq. ft.



Budget \$8,882,090



Schedule 8 months design 12.5 months construction



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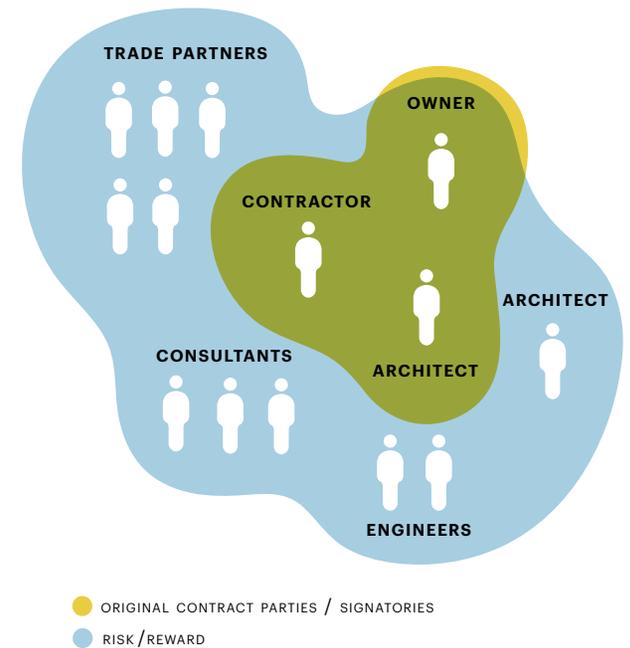
Project Description

The Rocky Mountain Institute (RMI) is a nonprofit group committed to advancing efficient uses of energy. As energy experts, they have worked with many building owners but have rarely played the role of owners themselves. This project embodied their considerable expertise in understanding what is possible today in energy and their ambition to lead the future of the industry. RMI understood the value of using this project as a model for the industry, in terms of team culture and the building's technical innovation, and set specific metrics for both team culture and building technology. Although integrated project delivery (IPD) is not typically used on projects of a scale this small, RMI was motivated to use it, believing the complex technical requirements and the desire to create a culture of collaboration were ideal for IPD. They also understood the potential for this project to be an exemplar in the industry for IPD's use in small-sized projects, especially those with big energy goals. Among the unique challenges of the project was applying passive house strategies to a commercial program and establishing goals at all scales of impact—from neighborhood to global.

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PREVIOUS RELATIONSHIPS

The architect and mechanical engineer, both based in Portland but with offices elsewhere, had worked together for many years. The architect had had a longstanding relationship with the structural engineer, going back fifty years. The architect had worked with their landscape and lighting consultants but not with the civil engineer or the local architect. The contractor and architect had prior experience working together, on approximately ten projects, but the project teams were working together for the first time. In the architect's view, "It was a good team that was able to overcome the hurdle of not having worked together before, but if the exact same team could go forward and do another project, we'd be in a position to move more quickly."



RMI PROJECT TEAM

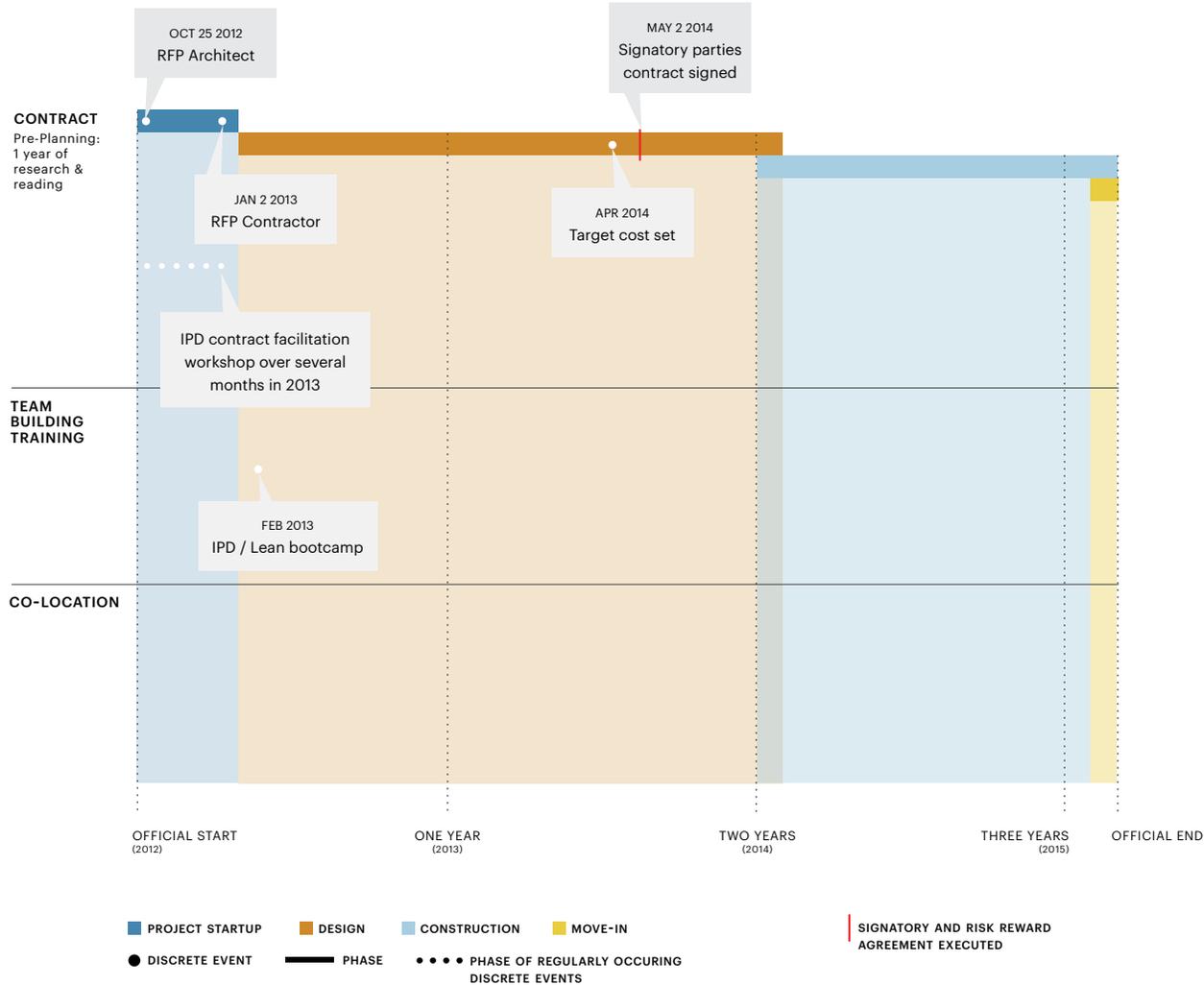
Rocky Mountain Institute Project Team

In identifying the project team, the relatively small size of the project and its remote location were factors. Some trade partners were skeptical about entering into IPD when market conditions offered so many traditional delivery options. The three signatories included the owner (RMI), architect (ZGF), and contractor (JE Dunn). The local architect plus three consultants and five trade partners were also included in the risk/reward pool.

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Project Timeline

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ROCKY MOUNTAIN PROJECT TIMELINE

The team worked collaboratively to ensure that a major delay in the window delivery didn't affect the overall project schedule. Revising sequences with Last Planner, the team saved approximately two and a half months.

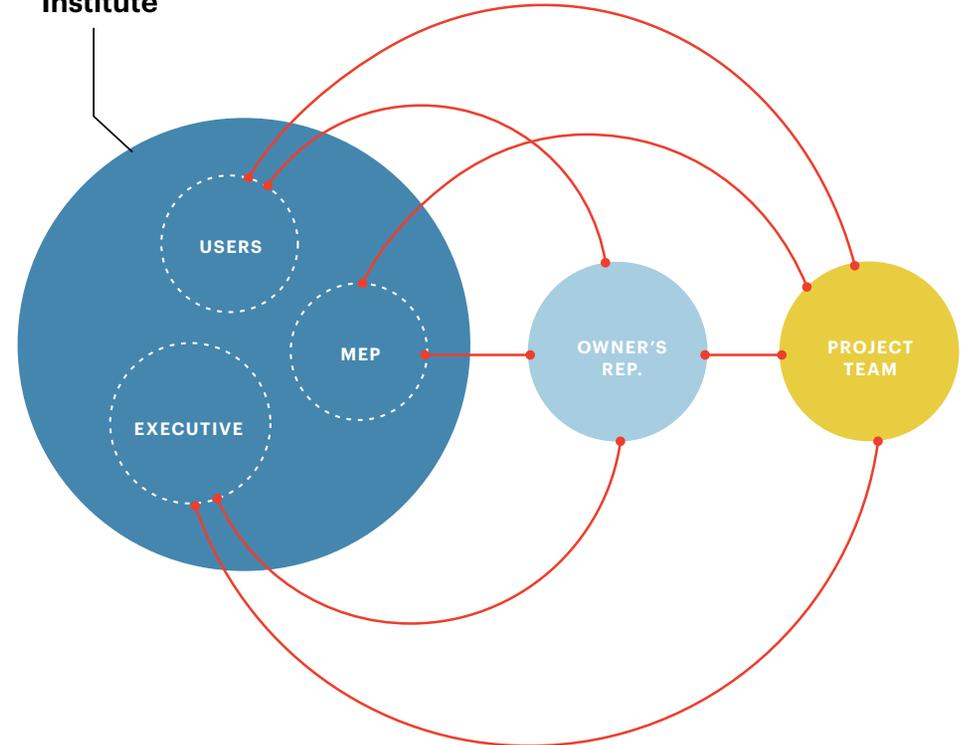
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Owner Identity & Interface

“RMI is probably one of the most democratic clients I’ve ever worked with,” commented the architect. “For some clients, they’ll be a CEO or a dean of a school, and they will be the ultimate arbiter of the decisions. In this case, it was a much more egalitarian, conversational meritocracy. We went through a lot of cycling and revisiting and exploration in order to get to something that the team agreed on. Generally, I think it worked. I do think it took more time. But in the end, it built a little more consensus, which is always important on a project.”

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Rocky Mountain Institute



KEY
MEP: Internal and consultant energy experts

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Choosing IPD & Lean

The owner, RMI, had experience in the building industry as energy consultants on other companies' projects, but they had not previously built a building for themselves, except a private house designed and owned by its founder, Amory Lovins, in 1984, which was used as RMI's headquarters. They were in the unique position of being a first-time owner with a great deal of experience, who could set informed goals. They wanted to leverage that knowledge to achieve a project that could be a model for the industry on several fronts.

The owner's choice of IPD was rooted in their organization's identity and goals for the building's performance and connection to the community, and a desire to "up the ante" and show the building industry what a high-performing team could deliver: "RMI is a nonprofit organization that is over thirty years old and has been focused on efficiency—efficiency across buildings, electricity, energy, industry, and transportation. We wanted a building that reflected those values and the work that we have done. We have a deep-rooted history in integrative design driving efficiency in those sectors." Their previous experience, in addition to carrying forward their organizational mission, revealed that their high-performance goals may face challenges: "In the construction industry today there is so much risk and liability, people aren't working together as a team, they are often working in opposition. That is not the way to achieve very aggressive goals like the ones we had put forth for our building. We wanted a project that was not only really fun to be a part of but also had a trust-based, very collaborative environment to achieve and push beyond our very aggressive goals."

The owner placed emphasis on two aspects of the project: the full life cycle of the building and the process of design, construction, and operation. RMI's expertise in life-cycle

cost analysis is based on the assumption that "energy does have payback," which they believe should be a major driver of day-to-day practice. In this project, they knew that life cycle was not typically engrained in the IPD process, and they resolved to find ways to incorporate it in as a major factor. In addition to typical cost and schedule, they sought long-term performance outcomes. "[Typical IPD contracts we reviewed] drive really hard at cost and schedule. We also wanted to drive hard at performance, and we ended up creating another agreement that really achieved long-term performance."

By using IPD, the owner ensured that the project team would remain involved after the project closeout: "We wanted to ensure that we were going to be able to operate the building the way that it was designed and intended to be operated and not have a huge cost liability on our books by not being able to control or predict the cost in operation." The owner believed the IPD contract would ensure continuity between design, construction, and operations: "We wanted to avoid that handoff in traditional practice of architects designing their piece and sending it over the fence to the contractor to build and then the contractor leaving right after the certificate of occupancy is achieved. The owner is left with a sense of 'What do we do with it now?'"

Although the decision to pursue IPD was holistic, the owner was very aware of schedule and cost pressures. The owner carried the cost on the lease for their existing building while running a capital campaign to raise funds for the new building. They had not taken these kinds of financial risk before, and they were able to use the IPD team to manage risk. They worked closely with the architect and the general contractor on a validation phase. The program from the validation phase was scaled back before the design phase to align with the

owner's fundraising targets and was informed by the general contractor's preliminary pricing to make sure the project was adhering to the budget. According to the owner, the ability to make informed adjustments to the budget at those key decision points was "a real benefit of IPD, having that kind of budgetary confidence. It reduced our risk of overrun significantly."

The team members had limited experience with IPD. The owner had experience with performance-based contracts but not with a multiparty agreement. The architects had limited experience with IPD and some experience with net-zero projects. This was the general contractor's fourth IPD contract but their project team's first IPD project; it was the contractor's first net-zero project. The MEP engineers had some experience with net-zero projects and had recently worked on Bullitt Center and said, "I would say RMI and Bullitt Center had a lot of similarities from the design perspective, and both projects had a highly collaborative team that jived really well."

- RMI, a first-time building owner but highly experienced with building industry as a consultant, had aggressive goals and wanted a team that could collaborate, and have trust and fun.
- Having a high-performing IPD team was extension of the organizational mission to "up the ante" for the building industry regarding energy.
- IPD provided continuity of team for building operations, so that energy-performance goals could be measured after occupation.

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Team Selection

To achieve a model delivery method for net zero, the owners wanted a project team who would set up a replicable process. The owner believed certain type of team member had that capacity: “We wanted the most sustainable teams possible. We wanted folks with the biggest deep-green net-zero energy experience.” Local companies were interested in the building since it was part of their community, but the site was remote and local parties had limited experienced with IPD or net zero.

Finding the right fit involved a combination of expertise and capacity. Both the owner and architect suggested names of major subcontractors and consultants, which were then vetted and reviewed. The architect helped the owner interview, made selections, and interviewed again, all within a month. The architect recalled that, together, they discussed potential risks and benefits. For example, for a large firm typically doing large-scale projects, the risk was: “Are they going to bring the level of attention that this little project needs?” For that same company, there were potential benefits: “They can handle these [complex] building systems. There’s a little bit more forgiveness if things don’t quite go right, financially.” For the critical role of mechanical engineer, the architect made a recommendation to the owner, and after a phone interview, that company was awarded the job and joined on trade partner interviews. The mechanical engineer put their team together based on who was best suited and who had time; many of the team had worked together previously on the Bullitt Center and brought their net-zero energy experience and interest in the project type to RMI.

The owner contracted design experts as owner advisors who were not directly part of the design team. In addition to the internal reviews by the advisors and team, the owner also

contracted PointEnergy Innovation to review the thermal comfort and mechanical design.

Early in the design phase, the team brought on trade partners that they felt had expertise that could contribute to the design process. The location of the project, in the Aspen River Valley, Colorado, is relatively expensive and remote. Therefore, finding the right trades and partners to work on this project was difficult and less competitive than a metro area. Additionally, the market at the time of the request for proposals (RFP) was extremely busy, and responses were limited. The contractor knew the local subcontracting community, and he proposed a list of teams, which the owner, owner’s representative, and architect reviewed and to which they provided additional names. The reviewers used a best-value selection and interview process for key trade partners, who were expected to participate in the risk/reward pool. They relayed their recommendations to the contractor, and he negotiated the contracts to bring the trade partners on board. The partners in the risk/reward pool included the mechanical, electrical, masonry, glass-and-glazing, and metal-wall-panels trades. One of the selection criteria for the subcontractors who were not in the risk/reward pool was how receptive they were during the interview to the core team and their sincerity of interest in the project.

The contractor was surprised that IPD was such a hard sell to the trades. He had expected that the subcontractors would be thirsty for this type of opportunity. He summarized their response: “Let me get this straight. You want me to put all of my fee at risk, and my performance on the job is potentially subject to how somebody else performs on the job. So I’m inheriting risk. If I perform well, and I’m a smart sub, and I do things efficiently, and I save all this money within my budget,

normally under hard bid, I get to keep all that money, but now you want me to give that back to you to share with everybody else on the team?” Furthermore, because of level of activity in the local construction market at the time, one subcontractor, encapsulating a general attitude, also concluded, “I’ve got ten other jobs on my desk that I can bid. I’ll take my chances on those and keep all the money that I’m going to keep because I was a smart guy and did a good job.” The contractor viewed the trade partners’ hesitation as a lack of understanding and an overestimation of the amount of risk involved in the project, and not having faith that the team could work together for everyone’s benefit. The team put together a three-page summary about the multiparty agreement and how it works and distributed it to the subcontractors. The owner felt the summary was “tremendously helpful.”

In retrospect, a lesson learned is that the market context can reduce interest in IPD. If there is an abundance of conventional delivery opportunities, IPD, as a new process, can appear more risky to trade partners.

- Several team members had participated in Bullitt Center, a net-zero project with a collaborative team that did not use an IPD contract.
- The owner’s criteria was based on qualifications and experience with “deep green,” not cost.
- The remote location made it challenging to recruit trade partners—many considered the project to be higher risk or lower profit than standard delivery.
- If market conditions offer many traditional delivery opportunities, interest in IPD may be low.

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Developing Contract

Contract Type: Custom by Hanson Bridgett based on their standard IPD agreement

The owner viewed the development of the contract as a learning experience. The owner’s representative was introduced to the ConsensusDocs 300 contract at a Lean conference and brought it to the ownership group for consideration. They met with the attorney to go through documents and determine the incentive compensation layer (ICL), but as the group worked more with ConsensusDocs, they realized it was not a good fit for them. After some discussion, they determined that their group needed more support than it could offer. They switched to the contract of the lawyer’s IPD expert, which they saw as more “user friendly.” The owners reflected that involving the legal consultants provided a great benefit to them and the project team: “It gave us great confidence as owners in the process, but he [the IPD expert, Ashcraft] also gave our consultants a really high degree of comfort as to what they were getting into. He presented [himself as] very fair and logical and was experienced about these contracts. How does the incentive compensation layer really work, and how does it pan out?” The owner also got Ashcraft involved with the other signatories as questions came up in the contract rather than managing the questions on their own. The owner’s representative offered this lesson learned: “None of us had done an IPD multiparty agreement, and we were trying to figure this out on our own. Surely, we could have, but had we brought [the IPD expert] in earlier, we could have probably saved ourselves a month of time dabbling with it.”

The owner referenced the contract several times throughout the design-and-construction process and also reached out to Ashcraft and his staff about items that differed from a

traditional project contract, such as change orders and the final completion certificate. One owner’s representative described, “As we come up to the distribution of the savings and the incentive compensation layer, just to make sure all the t’s are crossed and the i’s are dotted, I went back to the contract and re-read that section to make sure everyone was getting their fair share.”

The owner’s project requirements (OPR) was an important document on the project and was tied to the multiparty agreement as an exhibit. RMI developed a transformation dashboard (a tool they had used previously as consultants on other projects) at the onset of the project, in parallel with the request for qualification (RFQ) process, in order to frame what they wanted to get out of the project. The dashboard is a simple matrix with themes on the x-axis (energy, replicability, indoor environment, community, site, water) and along the y-axis (goals, solutions/actions, ripple effects). Each cell of the matrix has five to ten bullet points, such as “create places to stop, reflect, and sit” or “efficiency = reduced systems = reduction in size and cost.” The contents of the dashboard helped inform what went into the OPR, which is required on all LEED projects and is a standard template. In this case, the owner added to the template to include specific details related to passive house testing and energy performance, a new section on thermal comfort requirements and exposures, and a plan-B approach. The team spent significant time editing it throughout the early process. RMI’s project manager explained, “We didn’t lay out all of our targets in the multiparty agreement, but we referenced the owner’s project requirements and that document became a really important housing ground for all of those aspirations. It was great because it was a living document. Throughout the process, as we were experimenting with these new methods of thermal

comfort and how we handle the risk and liability associated with those, we used the owner’s project requirements to lay out what we needed and what risk we were comfortable assuming and how, and what risk we wanted to put on the design team.”

The owner and the team recognized that contract negotiations took significantly more time than for a normal AIA contract. The engineer recalled, “The contract itself was pretty challenging in that it was an unusual contract. It took an incredible amount of time for the design team all to agree to the contract. It was a disproportionate amount of time for the size of this project.” The owner estimated that IPD added a quarter more time to develop the contract than they had anticipated. Several team members reasoned that the additional time would have a return on investment since the contract would be published as a resource for future teams seeking to use IPD on projects of similar scale and aspirations.

- The owner and owner’s representative intended to use ConsensusDocs 300 but found that they needed more support than it could offer; they hired Hanson Bridgett, who eventually created a custom contract for them.
- The contract referenced several documents created by the owner, including a very complete owner’s project requirements.
- The contract negotiations took significantly more time than a typical contract, but the team invested time, with the goal of developing a model contract for smaller-scale projects with high-level energy goals.

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MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

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SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

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Developing Parties

The architect compared the financial aspects of IPD and traditional delivery: “[IPD involves] a very complicated documentation process that is different than a traditional contract. On a traditional lump sum contract, I bill until I’m all out of money, and it’s done with. I don’t have to keep track of every tiny little change order and how much goes to the incentive compensation layer versus how much I can bill for it. [Financial documentation] was an on-boarding process with the consultants that was very challenging.” The architect would have preferred to use a fixed-budget approach, so that the team could “go shoot the moon on performance” and see how far they could get. Nonetheless, the architect viewed the early recognition by all the players at the table that they were connected to each other by profit as a positive aspect of the contract.

A lesson learned at the end of the design phase was the impact of the ICL and risk/reward pool on the consultants. A few of the consultants were not part of the ICL, and in hindsight, team members commented that behavior would have been more aligned if everyone had been included.

According to the architect, for some of the consultants who were part of the risk/reward pool, the IPD structure was a natural fit, and for others, it was hard to adapt to the required mind-set, particularly around managing their fees. The architect observed, “I don’t know if it’s because the consultants have so many different projects, but several of them wouldn’t [realize] they were out of fee until they were in the hole. That just can’t happen on an IPD project. They’re taking money out of the ICL at that point. We really had to work closely with the consultants for them to understand that if they couldn’t tell the project management team and get approval that they were going to be in the hole on [their

fee before [the fee was spent]. They would have to deliver on the scope and wouldn’t be able to get [any additional work] covered.” Yet despite the fee issue, the architect saw that the whole team made sure that their scope was complete and innovative. Similarly, it took some of the consultants longer to realize the importance of jumping in and helping the team solve problems to retain the ICL. Also, since errors affected the whole team, when something was discovered, everyone on the team was informed. The architect recalled sometimes having difficult conversations with consultants who were not comfortable being called out for problems that might have resulted from their work.

Separate from the risk/reward terms laid out in the multiparty agreement, the owner developed what they call their operational performance pool, a pool of funds that accumulates from operation savings and the savings from photovoltaic panels (PVs). The pool was controlled under a separate contract to hold the architects, contractors, and engineers to the energy-performance goals they had laid out. They did not see a simple way to incorporate this pool into the multiparty agreement, and they did not want to hold the architect and engineer fees for over a year after occupancy until the operating goals were verified. As a result, they develop a new agreement that did not involve risk, only reward, which the owner illustrated, “We set a goal of meeting net-zero energy, and to do that we had a certain amount of PVs that we needed to install on the roof. We set a goal of nineteen EUI [energy use intensity], and we said if the team delivers the building and we are operating below that number, then we’ll have a pool of money that we will pay out that is divided between the architect, the contractor, and the engineer.” It is acknowledged that the actual performance of the building is heavily dependent on building operations, and

it is in the best interest of all members of the performance pool to ensure that the facilities managers and building users were involved in the design and understood the parameters of operation.

- The architect found the financial aspects of the contract “complicated” but acknowledged that the shared financial stake created a positive force for collaboration.
- Team members felt the contract was not well aligned with the owner’s holistic goals since it placed most emphasis on cost reduction instead of greatest value.
- Some consultants in the risk/reward pool found it more challenging than others to understand the connection between the incentive layer and their budgeted fee hours.
- In addition to the risk/reward pool, there was an operational performance pool tied to building-performance net-zero goals measured over the course of a year.

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Champions

The leadership from the owner drove the collaborative, integrated approach on this project. Although none of the team members had previous IPD experience, several commented that the agreement seemed secondary in importance compared to the owner’s approach: “RMI was completely convinced about IPD and integrated approach and set a tone of ‘We’re all here to work as a team and work together, collectively, for the greater good of what we want to accomplish here.’” One team member was able to draw a comparison with his experience on Bullitt Center, a deeply collaborative high-performing building that was delivered using standard agreements with clear goals. “The Bullitt Center, which is a very parallel project that didn’t have IPD, would have had exactly this level of collaboration. The more overarching piece is how to establish teams that feel that collaborative approach, whether it’s through a contract, through an owner that has a great vision that everyone buys into, or through other methods of team building. If you can do that, you’ll end up with a great project. IPD may be one tool. It’s a bit of a heavy hammer on a project of this size—all the hours we spent on IPD probably could’ve been spent on the design, or quite frankly, saved RMI a ton of money on design.” Arguably, the time spent on the agreement was extremely valuable in very clearly delineating the exact nature of the collaboration and the scope of each role within the team, setting the stage for a successful collaboration.

- The leadership of the owner group was convinced that IPD was the key to integrated design and successful net-zero outcomes, and they communicated that belief to the team.
- IPD seemed like a “heavy hammer” for the small size of the project, but the owner and team saw this as an opportunity to lead the industry in using IPD for high-performance buildings of any scale.

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Decision Structure

Decision-making was extremely democratic, with many contributing voices. In fact, team members mentioned that in team meetings it was often difficult to tell who was who because everyone offered opinions on everything. The engineer's perspective was slightly different: "We had a lot of really, really good collaborative full-team meetings during which everyone was welcome to offer ideas about everything and was listened to. We all dove in and made suggestions in other disciplines. It's hard to say how much the IPD piece contributed to that." The highly fluid exchange of ideas can be a marker of mutual trust and respect on teams that have a high level of psychological security. The support of this type of input by the team decision-making process can lead to innovative decisions.

- Decision structure was inclusive and democratic.
- Full team meetings were common.

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On Board & Off Board

When the trade partners were brought on early in the design phase, a significant amount of energy was put into making sure they understood what the team was trying to accomplish with IPD. As a result, some of the trade partners involved in preconstruction were well informed and “got it.” Yet, as observed by the contractor, when the work began to transition to others within the companies, such as project managers and site superintendents, the team and trade partners did a less-effective job of on-boarding. The contractor had hoped the IPD education would “cascade down to the guys that are in the trenches and the guys in the field who are actually doing the work,” but that was not the case. It was very common for those people to use typical, non-IPD, behaviors: “They’re used to the normal projects they’ve built, and that’s just how the culture is. The culture in the Rocky Mountains, or the whole of Colorado, is not IPD. They’re not used to it. So it’s a challenge to bring them on board.”

When ZGF Architects brought on new team members to the design team, introducing them to the culture of the team was more important than fully explaining the agreement. New team members who were known to be collaborative in their decision-making were easier to acclimate to the IPD process. “We didn’t always bring them up to speed on the depth of the contract and what they need to know about it, unless they were really going to be involved with the other team members or talking to the client or participating in meetings, because the contract is so difficult. It approaches things in such a different way. If you’re bringing somebody on who’s highly collaborative anyway, they will probably work out pretty well. But if you’re bringing somebody on who’s used to very traditional delivery formats, you have to spend a lot of time

explaining what IPD means, what the thought process is, and helping them get their head around community problem solving.”

- The initial on-boarding during preconstruction was very successful, but as work transitioned to field personnel, the principles of IPD were less well communicated.
- The architects focused their on-boarding on the culture of collaboration and did not emphasize the contractual terms of IPD.
- The surveys show that the team believed they could have done a better job on-boarding new team members.

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Clarity of Goals

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The owner's goals were unusually aspirational and very consistently communicated. According to the MEP principal, "It was crystal clear from the very start of the project what the goals of the project were, and they were unwavering in their goals."

Though the architect viewed making the most energy-efficient building in its climate zone in the United States as the owner's prime objective, as relayed by ZGF's senior architect, it was not the only goal: "There was a very clearly written vision statement, and there were four goals within that. The first one had to do with performance—'Create a building that exemplifies RMI's mission and program.' They wanted this building to be emblematic of what they're trying to do with their building's program. The second goal was to create the highest-performing building possible. The third was to create a replicable process and business case. The final was a beautiful structure with community outreach." There were smaller goals that supported these major goals.

According to the MEP principal, "This project had one of the best owner project-requirement documents of any project I've been involved in. The owner was obviously very sophisticated, and they understood the usefulness of that document. We've done over a hundred LEED projects. Sometimes the OPR is not really owned by the owner. They say, 'Oh, [why don't] the consultants write the OPR?' or 'Well, the idea is that it's your document, not ours.' But RMI really owned it. That became a document that was used as a true tool, and that's somewhat unique." The exceptional clarity of owner goals delineated in the conditions of satisfaction made the team feel like they had an "easy button" that if hit, would result in meeting project goals. The owner's project requirements were shared down the pipeline to the subcontractors and trade partners.

At a workshop meeting very early in the project, the team was illuminated to the fact that they were working on a significant project and that its unique nature lies in the energy performance, not the IPD structure. As relayed by the engineer: "There was this spirit of doing something really special together...When we all got together and the building opened, most of the people felt that it was the most significant project they'd worked on, even though it was so small. That kind of feeling really helped the team."

- The team characterized the owner's goals as highly aspirational, "crystal clear," and "unwavering."
- An owner's vision statement for the building guided the team along four major goals and numerous subgoals.
- The owner's project requirement (a typical part of LEED commissioning) was extraordinarily clear and well developed and became a touchstone for the team.

OBJECTIVES STATED IN THE OWNER'S PROJECT REQUIREMENTS (OPR):

Site: Enhance the existing environment and provide flexibility for new innovation.

Energy: Create a net-zero energy or regenerative building with aggressive efficiency.

Water: Create an aggressive water-reduction and reuse strategy.

Community/Transportation: Help define a new town entrance and enhance Basalt with a welcoming, walkable, transit-viable brain magnet that generates business activity.

Indoor Environment: Enhance core competency and brand identity of collaboration and convening while creating a wonderful employee experience with increased productivity.

Replicability: Redefine the cost of sustainable-building ownership and operation while emphasizing the financial value of paybacks beyond energy savings.

Sustainability Metrics: LEED BD+C Platinum, Living Building Challenge, limits in energy use intensity (EUI), passive house levels of infiltration, zero-net energy.

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Resources & Facilitation

At the owner’s request, the IPD/Lean facilitator compressed a three-day training into one day. Later, an additional one-day training was held. As recalled by the mechanical engineer, the intensity and novelty of the trainings “made the team gel pretty well because we had a lot time to get to know each other and bond as a team. We went through that [training] process and were indoctrinated at the same time.” While team members agreed the training was helpful to build the team, the short time frame and large amount of material made it difficult to synthesize the content and apply it to the project. The contractor believed the team underutilized their training: “If I were to rank that from high to low, I’d give us a low. I’ve been pretty critical in terms of how well we implemented that training on the job.”

As the team was working through the conditions of satisfaction, the owner felt more training was warranted, so the facilitator returned for a second full-day session. The owner said, “There were still a lot of questions about going from traditional to IPD, and people were getting confused by it. We had her come back because everybody had a bunch of questions about whether they were doing this the right way or the wrong way.” In retrospect, the owner would have invested in the full three-day training and also would have added a second training as a follow-up and third training after the trade partners were brought into the process. The owner recalled when trade partners joined, “our internal team, contractor, architect, owner, and a lot of the subs who were on at that time were engaged, and they had a rhythm going, understood IPD—it was a great collaboration. When we brought on the trade partners, they asked, ‘What is this contract model?’”

After the training, the team found that they had to adapt the Lean techniques to implement them effectively. For example, the team was trained on pull planning, but when they “tried it in the purest sense of the form, it was bulky and challenging.” In response, according to the architect, “we talked about what worked, what didn’t work, how to modify it, and what was good use of time.”

- A three-day workshop on IPD and Lean training was compressed into one day and proved to be insufficient; additional workshops were added.
- Pull planning was challenging, and the team modified it to work with their processes.

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Tools & Processes

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A project dashboard was used throughout the process. The architect hosted it during the design phase, and it was handed over to the contractor during the construction phase. The dashboard was a collection of various tools, including a weekly work plan with meetings, milestones, and deadlines, an action list, A3s, all of the working drawings, and construction photographs posted weekly by the local architect. Primarily used by the architect and contractor, consultants, such as the mechanical engineer, reported preference for working with the Bluebeam online markups. During construction, the contractor posted submittals to their dashboard and as the architect detailed, “We would develop a solution as a team, come to a conclusion, act on it, and then we would document that as, essentially, an RFI [request for information] done through the dashboard.” Though RFIs were not common, the architect saw them as necessary: “You’d hear people bragging, ‘We had zero RFIs on this project.’ We laughed about that when we were going through the process because to us, when used correctly, an RFI is truly a request for information. There’s a question. The contractor needs answers. Something isn’t clear. Documenting the answer to that question and returning it is not a bad thing. An RFI is only bad when somebody’s using it to say, ‘We have to increase the cost of a project.’”

Pull planning was an effective tool from the owner’s point of view, especially at the consultant level. The contractor was committed to using pull planning throughout their process and convened three major pull planning sessions. The team had Last Planner System sessions weekly with all of the subs: “We would implement Last Planner into our master schedule with all the details to really be able to monitor the schedule.” The architect developed a modified version of pull planning: “We still projected our time frame out, but then we would do a pull planning–like session to make sure that everybody

was still going to make their deadlines and be on track. Who needed what from whom? It was just a slight modification, thinking about a schedule that was more appropriate for the project scale.” The mechanical engineer felt that Last Planner System kept the team on track since “people could light a fire pretty quick, and it became pretty obvious that you’re falling behind.”

For cost control, the owner’s representative used an Excel-based tracking system they had previously developed: “We tracked every single consultant, every cost, every invoice. That was quite a laborious part of the contract, tracking every single cost. It took a lot of time to do that.” In retrospect, the owner could not envision going through a project like this without the level of cost confidence and granularity that the system brought to the project: “I can’t imagine using a commercial product that didn’t have the flexibility, because we have added and changed and modified things based on what we needed to see and who we needed to present that information to.” The contractor and architect used the cost-tracking system extensively, but the system would have had more impact if the subcontractors had used the information. The owner said, “They had access to that granular information, but from what I could glean, there was a monthly tracking call with all the trade partners and it was just an around-the-room consensus of ‘How are guys trending toward your budget.’ And it was just thumbs up or thumbs down.”

Concerned with the relatively low level of cost-control engagement by trade partners, the owner prioritized tracking costs from the project consultants for whom overruns could have a significant impact on the overall budget. She didn’t want to find cost issues late in the process. “We wanted to respond early in the game and ask, ‘Why are you guys tracking

so high? We need to make some adjustments here and what would those be, and are we comfortable with paying more money?”

Even though some of the team members had used it previously, the team did not use reliable promising. The contractor held the view that it is more difficult to use on a smaller project, since everyone is already talking to each other. The team used a risk register early on that they collectively reviewed and managed together as a team.

- A project dashboard was managed by the architect during the design phase and then transferred to the contractor during construction.
- The requests for information were documented in a streamlined way through the dashboard.
- A “granular level” spreadsheet tracked cost and was very effective for the architect and contractor; it was less used by the trade partners.

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Lean Effectiveness

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Plus/Deltas were instituted by the owner and used throughout the process on the project management team level, with the owner, owner's rep, contractor, and architect contributing to them monthly. They were seen as providing a benefit in return for a reasonable time investment. The architects found Plus/Deltas to be effective for design decisions and have adopted it on other projects in their office: "We found that it was a good format to get feedback on what people liked about a design option and what needed change." The architect found it particularly helpful for complex design proposals in which there might be some positive and some negative aspects. Plus/Delta allowed feedback to be focused instead of "just throwing darts at design options that maybe still have had good ideas but that somebody didn't like one element about." The contractor has continued to use Plus/Deltas in other projects: "In most of our meetings in the company, we don't call it Plus/Delta, but it's the same thing. We actually call it 'do more, do better,' but we, culturally, use that on all of our projects and in all of our meetings." Based on his experience with this project and others, the contractor believed that Plus/Deltas had the most impact early in the project, diminishing once the project hits its stride.

The owner's representative had seen presentations on the effectiveness of A3s and suggested use on the project. The team used A3 to track critical decisions and found them to be effective in reducing back-and-forth exchange. The team used them heavily in the validation and early schematic design phases but later in the process drifted away from their use because, according to the architect, "we really weren't making the level of decisions that required documenting something quite so completely. We ended up issuing ten or twelve of them." The mechanical engineer did not remember authoring any A3s and felt they could have done better using them

to document certain aspects of the job: "There was some confusion at the very end about around the battery system, about what the intent of it was and how it should have been designed." He explained that their understanding of RMI's needs didn't match what RMI intended to communicate.

In contrast to the positive comments from the team, the owner believed that the A3s were too cumbersome to use and also found the full-team meeting to be too intensive and ineffective.

The team used elements of target value design but did not feel they used it in its purest form. "I don't think we ever really, in earnest, tried to do target value design," the contractor commented. "It wasn't as though we tried it and then threw in the towel. We just never embarked on it. Honestly, we would have needed more facilitation or coaching or somebody who really understands that process to do it." He went on to say that there was a high degree of "transparent budgeting and decision-making and cost exercise between, primarily, [the preconstruction manager/estimator for the contractor] and the whole design team."

- Plus/Deltas were used effectively and provided benefit without a large investment of time.
- A3s were used to track critical decisions early in the process; some team members felt they should have also been used more in the later stages.
- Target value design was not used, partly because of a lack of familiarity with the process.

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BIM

The RFQ specified the use of BIM on the project, so it was understood from the beginning that BIM would be used. While the team utilized it on the project, it was not integrated with the energy model. Team members were mixed in their commitment to BIM: some believed the project was too small to justify the investment; others reported benefiting from BIM, especially after different models were integrated and the full design team could jointly review consolidated models and solve issues quickly. Some fabrication was also driven by modeling.

Key team members agreed that the use of BIM was a substantial benefit in a digital mock-up of the envelope. The contractor used the architect's model to create a 3-D model showing each layer and demonstrating the assembly. This was particularly important for understanding air barriers in the passive house system, specifically for technical details, such as for fastenings and connectors. The contractor, architect, and trade partners praised the model as essential to the success of the envelope.

For the energy modeling, the owner wanted to use software that could integrate daylighting and energy components. Although the MEP proposed using multiple models, the owner had a strong preference, based on their expertise in modeling, for an integrated model, and the team eventually implemented Information Energy Services (IES) Virtual Environment. The energy model, built by the mechanical engineer and used as a design tool, was a very collaborative tool and allowed the whole team to own the energy goals for the project and understand what they needed to do for performance. The architect utilized the energy model when they were designing the operable windows and to determine how they would work with natural ventilation. The contractor

saw that the team, including the engineers, architect, builder, and trade partners, came together around the integrated model: "Those instances when we were drilling into a weak spot, we were able to solve that right away." The energy model was also being used to verify building-operation measurements for the remaining part of the incentive funds tied to performance.

- The primary benefit of BIM was in the envelope assembly, testing the passive house wall systems.
- Energy models were extremely helpful to the team but were not integrated into BIM.

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AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE

MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

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Workplace

The remote location of the site was a challenge. From the owner’s point of view, the distance “set us apart from what you would normally see in a city where everybody just drove in and could work out of a Big Room type of space. We didn’t have that, so we had to modify.” For the architect, the scale of the project and team size was unique: “It was a very big team for the scale of the project, but it wasn’t big enough for most of our team members to be full time. It didn’t make any sense to co-locate, because, as you can imagine, a structural engineer, even in the busiest periods on the project, is likely not full time—nor is landscape or civil or many of the other disciplines. It wasn’t like on a really big IPD project, where you’d stick everybody in the same room, and they’d work together on the project nonstop for five months and crank it out. We had to develop a different way to ‘co-locate’ and a different way to communicate schedule and do pull planning and those kinds of things.” The contractor viewed the dedicated time the team spent together as possibly more effective than the typical Big Room or co-location approach: “At some point, the designers need to go and do their work, and they don’t need me or an estimator looking over their shoulder every time they draw a line. So we’ve had good success, whether it’s a two-week or three-week or monthly cadence, depending on the project, and you get everybody together for three or four days.”

Visual communication was very effective for this team, and after their experience with RMI, the contractor has made a regular practice of creating posters for their project conference rooms. “It’s that in-your-face communication. In the conference room of the project, for example, the conditions of satisfaction are hanging right there on the wall. So you can’t miss it. So it’s almost a billboard-campaign type of reminder.”

Another effective communication tool was an interactive drawing system managed by the contractor and created by digitally scanning all of the drawings and creating tags that linked between sheets.

- The remote location of the site and the small size of the project made co-location unfeasible.
- The team developed a co-location equivalent with a regular cadence of two- or three-day meetings on-site.
- Visual communication was effective—for example, the conditions of satisfaction were posted in the conference room.

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Team Alignment

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A key document the team developed was the conditions of satisfaction. The owner’s representative said the document “was a really important tool in the very beginning for really defining what a conditions of satisfaction is, what it means to everybody in the group, and what the language was.” The contractor had a different view: “I’m not sure that we were as disciplined as we should have been about either posting that information or communicating it. That’s not to say that we lost sight of it altogether. At the end of the day, we accomplished everything that we laid out as a team.”

“When we would get to a particularly difficult time,” the senior architect reflected, “if there was any tendency to point fingers at someone who did something wrong, we all had the saying, ‘Well, that’s not very IPD.’ It would redirect the conversation to an understanding that we had to collectively solve the issue and not necessarily worry about what created the issue. It kept people in a collaborative mind-set in some very challenging times.”

The engineer, as well, witnessed specific team behaviors on issues related to cost: “What’s a bit unusual about IPD contracts is that a mistake made by someone who’s not involved can affect the entire team. Someone can choose the wrong paint color, and yet, the mechanical engineer may pay for it. That’s unusual. So everyone on the team ended up looking at costs in a different way.”

The architect saw a slight misalignment between the priorities of contract and the owner. She noted, “The language and the motivation intended in that [legal consultant’s] document is all around cost reduction.” From her view, RMI was primary interested was in value relative to performance, believing they wanted to use “every penny to create the most efficient

building possible.” She found the contract focused on motivating the team to find cost savings, but in this case, cost was only one factor in the value proposition. From her point of view, the team was motivated around the owner’s challenge: “Can we go a little bit deeper on the performance?” The contractor viewed the contract as contributing to furthering the owner’s goals of pushing the limits of passive systems and the boundaries of traditional engineering as it related to HVAC systems in particular.

The shared management of the project contingency was a positive force in early team and trust building. The contractor described the situation: “You’re looking at that \$6,000 contingency, and knowing that you’ve got a year to go and haven’t even found any of the unforeseen yet can be very scary. It really pulls the team together early, builds the trust very quickly.” The open-book relationship allowed the contractor to make product changes and reduce materials to get costs back and reduce the budget early on. “We would trade off things—‘We’ll eliminate this, but we’ll give you that’—and the design team and owner would do the same with their changes.

A project engineer described a conversation during which a team member realized how differently this project was structured. “Some trade partners flat out missed some stuff that was clearly on the drawings. They missed it in their estimate. They missed it in their bid. Our electrical engineer started reacting the way she would react on normal projects, which is, ‘It’s on the job. It’s clearly on the construction documents here. Why’d you miss it? You guys should pay for it.’ She was quickly corrected. The way the contract is written, everyone pays for everyone else’s mistakes.”

The architect saw that the team came together to find solutions. The good ideas floated to the top, and they collectively determined which approach to take based on what was best for the project: “There were times when we were cognizant that there were things that were really important, and we would do it, even if that meant that the risk/reward pool was going to go down. There were times when we realized that things maybe weren’t as important, and we would figure out a better way to achieve a good result without having to spend so many construction dollars. It’s constantly there in your mind. It also makes you lie awake a lot at night when you know that there are things that are going wrong, and you don’t have a solution for it yet. It keeps you up thinking.”

- The team understood the phrase “Well, that’s not very IPD” as a cue to redirect behavior when someone reverted to a traditional mind-set.
- Team members came to understand IPD at different times; peer mentoring helped bring the whole team into alignment around IPD.
- There were times when the team decided to do something for the benefit of the project even if it negatively impacted the risk/reward pool.

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Collaboration

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The IPD agreement was extremely powerful in helping the team manage the scope of their work, which resulted in major savings to the individual firms. According to the engineer, “One of the positive things that the contract changed was our ability to raise our hand and say, ‘Hey, this is outside of our scope.’ A lot of the times, for little things, you’ll just do it, and it gets wrapped into your scope. But in this case, because it fits into the team bucket and we’re all working out of the same budget, there was a target-cost process that put a hard cost on everything. If there was something that was out of the scope, everyone needed to be on top of that and alert the whole team” The team put in time together to resolve scope increases, such as extra work on solar design and other smaller details that eventually added up. The engineer estimated that these increases accounted for approximately 10% of their total fee, which would normally have been absorbed into increased scope.

Another major savings to the schedule came from collaborative behavior supported by the IPD agreement and the team culture of collaboration. There was a schedule problem with the metal-panel curtain wall, and the architect helped the contractor resolve the issue by accepting a finish change—from anodized and painted to anodized only—so the material could get to the job site faster. There were also several issues with glass, and the contractor recalled that owner became directly involved with the supplier in order to help. The architect viewed the issues with the metal-panel installation as indicative of the team’s collaboration: “It didn’t depend on me, as the architect, lying awake at night to solve the problem and propose it to the team. It would become a collaborative effort to solve a problem and propose it to the team. Just by walking the site with the job foreman for the

metal panels, because we were all there, thinking together about the best solution, we got done in several hours what would’ve otherwise taken a very long time if we’d done it through more traditional documentation methods.” Though the final installation was different from the original design intent, the architect viewed this aspect of the project as a success.

For some team members, tracking and predicting time was difficult. The owner recalled challenges with the contractor around the issue of producing accurate and timely cost estimates and had several direct conversations with them. The architect found it relatively easy to track hours but challenging to predict hours. The architect described how she found ways to give enough information about the designers’ time that the team could create realistic project plans: “We could give them [the rest of the team] some rough order of magnitude—‘Hey, we think this is going to take us about two weeks of time, two people working on it.’”

Team members trusted each other to find the lowest cost solution for any changes. The contract’s incentive structure helped support this culture. The contractor cited the following example: “Let’s say the architect made a change. We would then review that in depth. The architect definitely had incentive to try to avoid cost increases because he knew the budgets that we were working with. I think that [motivation] would flow down to some of the superintendents or project managers. [The superintendents and project managers] were always trying to find the best solution for problems or changes, to make them the most cost-effective. So as far as the financial incentive, I definitely saw it in a lot of the foremen, who, if they needed to do something extra, wouldn’t charge any time or make me sign an extra charge sheet for a

few hours here and there, if it was something minor. I think there was one change order for labor.”

This type of behavior was limited to those in the risk/reward pool. The contractor noted a fiscal disconnect between partners included in the IPD contract and those outside of it: “It was easier with the partners in the agreement because they knew the contract language. They knew they were part of that IPD, and their fee and their risk were tied to the group’s. But if it was a non-IPD partner, we would very quickly and easily get change orders sent our direction because it was more of a typical hard-bid project [for them]. We didn’t have those trade-offs with them as much. They were not as aware of the nature of an IPD-project arrangement.”

- **Prioritizing benefit to the project resulted in additional scope for some team members. The engineer identified 10% of their total fee as additional scope and resulted in significant value to the project.**
- **The team was able to compensate to make up for a significantly disruptive two-month schedule delay.**
- **The contractor noted a difference in behavior between those companies with stake in the risk/reward pool compared to those without.**

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Team Culture

The team believed that one of the project goals was to have fun and to form long-term friendships that would outlast the project. The engineer observed, “At the end, we all emerge as friends. I have new friends because of this team, people that I still see after work and do stuff with.”

The team characterized their interactions as highly reflective, very respectful, and self-aware. The contractor remarked that the team “would have routine meetings just to talk about lessons learned on IPD or reflect on how everybody felt like things were going.” These discussions served as a metric that complemented the building-performance measures but “was softer than some sort of hard-driven metrics,” as one team member asserted. Clearly, this project was a career highlight for many of the team members, and comments such as this from PAE Consulting Engineer’s project manager were common: “This project was a really exceptional project to be on. It was a highlight of my professional career to get to work on this project.”

In retrospect, the owner believed the team’s “impressive degree of care and integrity” generated deep trust that kept the project on track, that without it, “it would’ve been really hard for me to have that degree of trust in what they were doing, and it could’ve gotten ugly really quick.” The owner reflected that the IPD process worked well for keeping the budget and team on schedule, but their lack of experience meant they did not get the “true experience” of IPD that might have resulted in even more impressive results. “If we were to work together again, we could probably cut three months out of the beginning of the process with the contract development and ramp up for the project because all those nuances have been narrowed down. There is a learning curve

to IPD—the second time you are going to be so much more efficient, you could blow the doors off of it.”

- Several team members commented on the friendships they made, including social connections outside of work.
- It was common for team members to say this project was the highlight of their careers.
- The owner developed a deep trust in the team after seeing their “impressive degree of care and integrity,” without which things “could have gotten ugly.”

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Profit & Payout

In addition to the goal of integration, another reason the owner pursued IPD was to achieve transparency around cost: “My goal and intention of that is that it is very clear how all the costs are allocated and that there is no question on anyone’s mind that the savings that are being distributed among the team are 100% there and 100% to the contract.” They believed that transparency specified by the IPD contract provided verification that supported the culture of trust: “I think this group has a ton of trust because everyone has been trustworthy and honest through the process, but rather than just having trust, there’s the opportunity to trust and verify.” The owner also observed that everyone on the team was proactive in adding back to the ICL with a project-first mentality: “Some subs are over and some are under and everything in-between, and people have been really great about saying, ‘I don’t need these expenses. Put it back into the ICL.’”

Travel to the remote site had been budgeted early on, but the team had regular discussions to determine which trips were necessary. By strategically using travel, travel costs were reduced. As stated by the owner’s representative: “The mechanical engineer recognized that their staff didn’t always need to be there, and we could hire a third-party mechanical engineer based in the valley. They can go by the site, review the mechanical system for us; they can take pictures, send us the information. That way, we are spending just the hours and a little bit of driving time for this third-party engineer. That alone probably saved us \$6,000. For other consultants, it was being cognizant of ‘Sure, we have all these travel days allocated. Which ones are truly necessary?’”

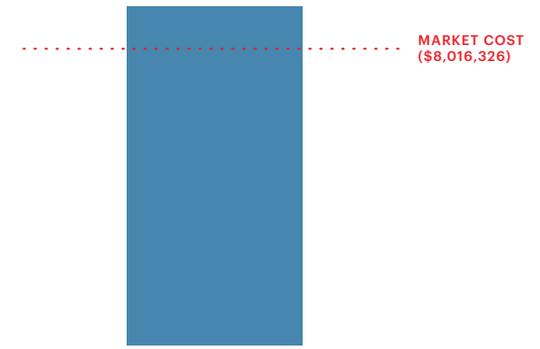
The architect ended up slightly under budget on fee at the end of the project. “We are pretty excited about that. We

were generally on budget, all the way through the design phases. We were over budget in the construction phase and could have spent even more. We managed very tightly to our fee, to try to hold it. We were able to come in under on a few associated fees, like LEED certification, LBC [Living Building Challenge], expenses, a few other areas. In the end, that’s how we ended up in the positive.”

The team felt that the initial contingency was very low, that having a \$6,000 contingency on an \$11M construction project, which would typically have closer to \$300,000, was a challenge. The \$6,000 contingency was the only remaining contingency when the final target cost (FTC) was developed, and the FTC was not allowed to exceed the base target cost. Once the design was complete and the project procured, that originally planned contingency, which would have been carried at the beginning of construction, was down to only \$6,000. The contractor kept track of the overall contingency: “Based on starting with \$6,000, we ended up [quite a bit] over that. We traded off and on between trade partners and regular subs and all that.” The result of the trade-offs was a contingency large enough to accommodate a project of this size and scope.

In addition to the ICL reimbursement, there was an operating performance pool fund provided by RMI to be paid out eighteen months after occupancy based on the actual operating energy use intensity (EUI). If the building were to meet or exceed the design target of 19 EUI (kBtu/sf/yr), RMI would pay a small reward to the architect, MEP engineers, and the contractor. The team understood that the reward was the equivalent of the operating cost of a couple of years.

- The owner believed fiscal transparency allowed the team to “trust and verify.”
- Team members collectively developed a strategy to limit the number of trips and return funds to the incentive layer.



ROCKY MOUNTAIN PROJECT COSTS AND PROFIT

Because the final target cost was not allowed to exceed the base target cost, the contingency available on the project at project start was only \$6,000, or 0.05% of the \$11M budget. Over the course of the design and construction, the team made many small savings totaling about \$50,000, which could be used to add value to the project. The project is about 10.8% above market, a premium for net zero and for high-quality finishes. This investment will be paid off in four years, based on expected life-cycle cost savings.

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Budget & Schedule

“It wasn’t just the aspiration of a high-performance building, but combining that with the real cost [limitations] was where the true challenge came,” declared the architect.

The contractor and architect had very positive exchanges around the budget. The contractor took pride in the level of detail provided in their budget estimates and felt there was good dialogue around the budget with the architect. They paraphrased their interaction as: “We made assumptions at a very early state of design, during conceptual-level design, in terms of level of finish, detailing, those types of things, so that we all collectively owned the budget together, and we were designing to the budget.”

The architect came to trust the contractor because of their actions, resulting in efficient management of construction-administration fees. The architect commented positively about the contractor: “Doing things on-site, not always asking for small RFIs or time-consuming elements of a construction process that tend to eat the fee, and by resolving issues through a phone conversation or an email of documentation were important. We learned to be more efficient with our construction-fee dollars. The contractor helped us to do that.” The architect, in turn, saw the ability to think through effective use of construction dollars by questioning the need to redesign and produce new drawings when issues arose: “It opened the door for us to be able to say, ‘We could do that, but it’s going to cost us \$8,000 in fees for a change that’s only going to save us \$2,000. So the return here is not good.’”

The ability to smoothly resequence and recoordinate the construction in response to unforeseen changes was seen as a positive effect of the open communication within the team. A major issue was a ninety-day delay in the delivery

of the curtain wall, which was fabricated in Germany. This could have had a negative effect on the schedule, but the team was able to work together to resolve the issue without impacting the overall schedule. When the delay became known, the architect (who would not normally be involved with construction-delivery or manufacturing issues) worked with the contractor and subcontractor to revise the finish specification to one that was the fastest to manufacture. Originally, some windows were anodized and some painted. After understanding the schedule limits of the manufacturers, the architect agreed “to keep it all anodized, without having it painted once it got to the States, just so the material could get to the job site faster.” They also helped revise the sequence of construction to absorb the changes. Another time-saving change was beginning the standing interior walls before they had the cross-laminated timber and other structural elements. The contractor recalled, “We had to sit down with the subcontractors and resequence the original plan task.” The contractor attributed this modification to Last Planner System: “We overcame what could’ve been a job that was delivered many, many months late.” Again, the team was able to absorb major schedule delays without overall delay to the project. The contractor’s project manager described the two delays, which totaled two and half months: “The structure of the building showing up to the job site a month late, the curtain-wall system out of Germany showing up a month and a half late. With that being said, we were able to restructure the building process and absorb those hits and still completed the project on time. I can’t say that we finished a month early or anything like that, but even with the issues that occurred, we met what we set out to do.”

- The project contingency was extremely low, and the team successfully managed trade-offs to add value to the project without exceeding the contingency.
- While target value design was not used, the team felt they were collaboratively “designing to the budget.”
- The team successfully mitigated a two-month delay in the windows delivery. With collaborative changes in many areas, the overall project schedule was not affected.

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Building Outcomes

The building-performance goals were clearly defined and very prescriptive, making it relatively easy to align team members. According to the MEP's project manager, "Certainly, thermal comfort was a very actionable departure from the usual design documents. Net-zero energy was very actionable and something we had to work with an entire team for." The team created actionable goals around specific requirements, even as the targets shifted. The engineer's project manager said that the team figured out "what made sense, what technologies were available."

The engineer's perception was that RMI very much wanted to move beyond the boundaries of traditional engineering and the limits of passive systems. RMI's culture made it acceptable to push the envelope of building occupants' thermal comfort zone, and the engineers designed to a much greater temperature range than typically found in American projects.

Another project element that pushed typical boundaries was RMI's desire to use certain exterior-wall products not common in the United States. By using these products, the team created an innovative window system with the help of the trade partners "that was really unprecedented. It had its challenges and some flaws, but that was one of the risks in the programming and some of the elements pushing the boundary." The system employed four layers of glass with two films, three air gaps, and 90% krypton in an aluminum frame.

An unlikely voice for innovation emerged from the mechanical trade partner, who stood in a unique position: the project goal was to reduce or eliminate his work. PAE described how a potentially awkward situation turned into a constructive discussion: "We did eliminate most of his scope, which must have been difficult to see because he's sitting in these meetings where we are saying, 'Get rid of it,' about his scope.

All of a sudden, his work, and quite frankly his profit, goes away. At the end [of the meetings], he brought up some really interesting questions. 'Let's say this doesn't work, and I, the mechanical contractor, gets called back to fix it and to turn the dials. These guys haven't left me any dials to turn. What am I supposed to do?' This actually led to a really good discussion and a whole series of commissioning things that answered the question of what to do because there are no dials to turn."

Passive house standards set air-infiltration goals, which the team met and exceeded. The building also achieved LEED Platinum. The team is still in the process of documenting the project to achieve the Living Building Challenge Petal Certification.

RMI is still in the process of adjusting for and determining building performance. "One of the pain points we still have in this industry is data management, and we are still in the process of integrating all of our submeters to actually track where energy use is going and how our PV is performing. There were some adjustments and corrections that needed to be made after the utility bills from the first couple of months, and now we are have a much better sense of how we are trending compared to what we projected. Week by week it is getting clearer."

PROGRAM/TENANT SATISFACTION

The building was designed to meet air-temperature targets and metrics around thermal comfort of the occupants. The metric was set at 90% satisfaction. In the eyes of the PAE engineers, "This is something RMI was really great about. They demanded that we look at the six factors of thermal comfort: air temperature, humidity, air speed, radiant temperature [the temperature of surfaces around the room],

occupants' clothing and metabolic rates. Everything, except for clothing level and metabolic rate, are being measured in the building. If RMI starts to perceive that it's uncomfortable, then they would go to [post-occupancy] surveys to figure out the last two. 'Are people using the building correctly?' they would ask. We actually had all those things in our design documents—'This is what you're supposed to wear in the space in the summer, and this is the level of activity you're supposed to have.' It was literally on the drawings."

- The net-zero and passive house goals were extremely clear; the team used the most current technologies to achieve subgoals and push the limits of passive systems.
- The mechanical trade partner's scope was very limited since so many systems were passive. He supported this effort but pointed out that systems controls were needed in case performance had to be adjusted.
- User-satisfaction goals and performance over time were harder to measure at this time.

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MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Project Credits

PROJECT TEAM

Signatory Pool

Rocky Mountain Institute (RMI), Owner
 ZGF Architects, Architect

JE Dunn Construction, Contractor

+Risk/Reward Pool

PAE Consulting Engineers, Engineer

KPFF Consulting Engineers, Engineer

Graybeal Architects, Architect

Architectural Applications, Consultant

DHM, Consultant

DNA, Consultant

Alliance Glass, Trade Partner

Mtech, Trade Partner

Gallegos, Trade Partner

Gen3, Trade Partner

Elight, Trade Partner

INTERVIEWEES

Owner & Rep

Tripp Adams and John Perko, True North Management; Cara Carmichael, RMI

Architect (ZGF Architects)

Kathy Berg, Justin Brooks, Chris Chatto

MEP (PAE Consulting Engineers)

Marc Brune (Project Manager), Paul Schwer (Principal)

Contractor (JE Dunn Construction)

Luke Godwin, William Peterson, Mike Tilbury

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Project Description

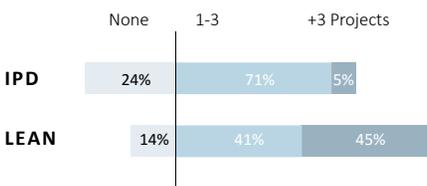
PROJECT	St. Anthony Hospital
LOCATION	Pendleton, OR
BUILDING TYPE	Healthcare
PROJECT TYPE	New Construction
CONTRACT	Custom
OWNER	St. Anthony Hospital Catholic Health Initiatives
ARCHITECT	ZGF
CONTRACTOR	Sellen Construction
PROJECT START	May 2013
COMPLETION	September 2013

Project Images



Photo Credits: Benjamin Benschneider Photography

Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 22

The majority of the team had prior experience with one to three IPD projects, with few members having greater experience and some having no experience. The team also had high Lean experience, with only a few members having no prior experience. Most of the team members had some prior working experience together on previous projects, and approximately half of the team had worked previously with the owner.

Building Size 105,200 sq. ft.



Budget \$74,180,000



Schedule 11 months design 16 months construction



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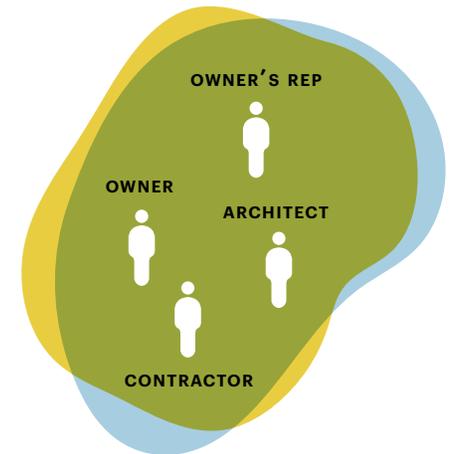
Project Description

This ranching community relied on an outdated hospital originally founded in 1901. After many additions and renovations, it was operationally inefficient and difficult to maintain or upgrade. A highly motivated volunteer advisory board, made up of key members of the community, researched options and became persuasive advocates for a new facility. The Colorado-based health care owner was convinced to invest in a replacement facility to be located on a greenfield site on the edge of a small town. They expected the new hospital would meet much higher efficiency goals, and the footprint of the new building was planned to be less than half of the existing building. The new facility provided a small market-growth opportunity for the owner by providing services that were not currently available in the community, but since the demographic profile is not expected to increase, this was a small factor.

There were two prominent challenges for the project: creating a complex and technically sophisticated building in a remote location and completely revising hospital operations to work within half of the amount of space. The remote location meant there was a limited market of local subcontractors. The hospital staff developed a guiding principle, "the patient is king," to keep the end-user experience in mind as decisions were made about new ways of working with greater integration and less space.

PREVIOUS RELATIONSHIPS

The emphasis on individuals within the local community and those connected to the larger network of regional firms seeded the team's culture with several strong pre-existing relationships. The owner's representative had an established relationship of about eight years with the CHI board, and had also previously worked with the architect, ZGF, and the contractor, Sellen. The contractor had a strong existing relationship with the owner, a strong relationship with the architect's Seattle office, and was very familiar with a majority of the subcontractors.



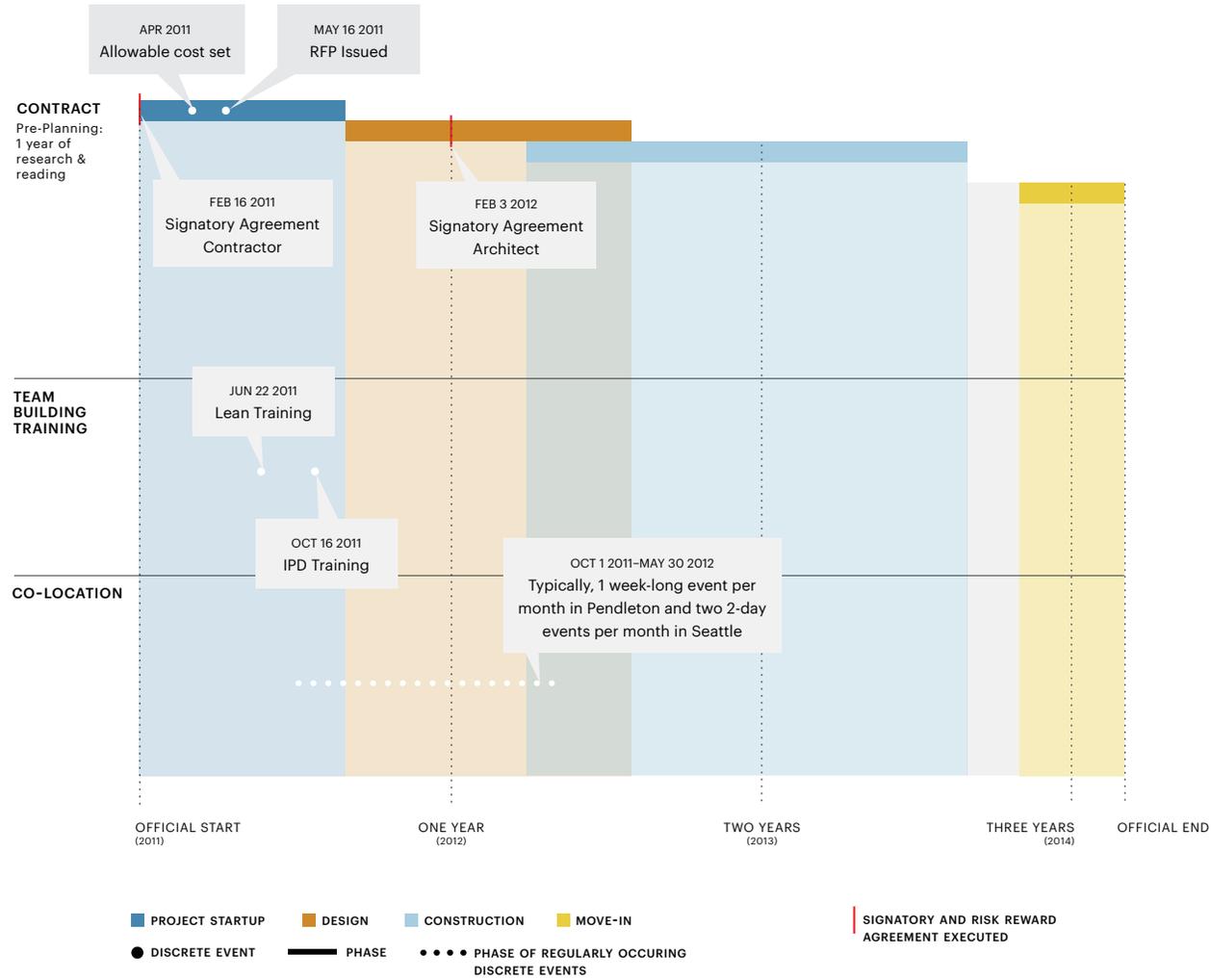
ST. ANTHONY PROJECT TEAM

The core team considered the project to be closer to IPD-ish since the CHI owner's contract was relatively traditional and limited the risk/reward pool to the owner's representative, contractor, and architect. The four signatories included the owner (St. Anthony Hospital, CHI), architect (ZGF), contractor (Sellen), and owner's rep (The Healthcare Collaborative Group).

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Project Timeline

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ST. ANTHONY PROJECT TIMELINE

The project team completed several months ahead of schedule, which saved an estimated \$1.2M. High levels of collaboration allowed early and parallel work.

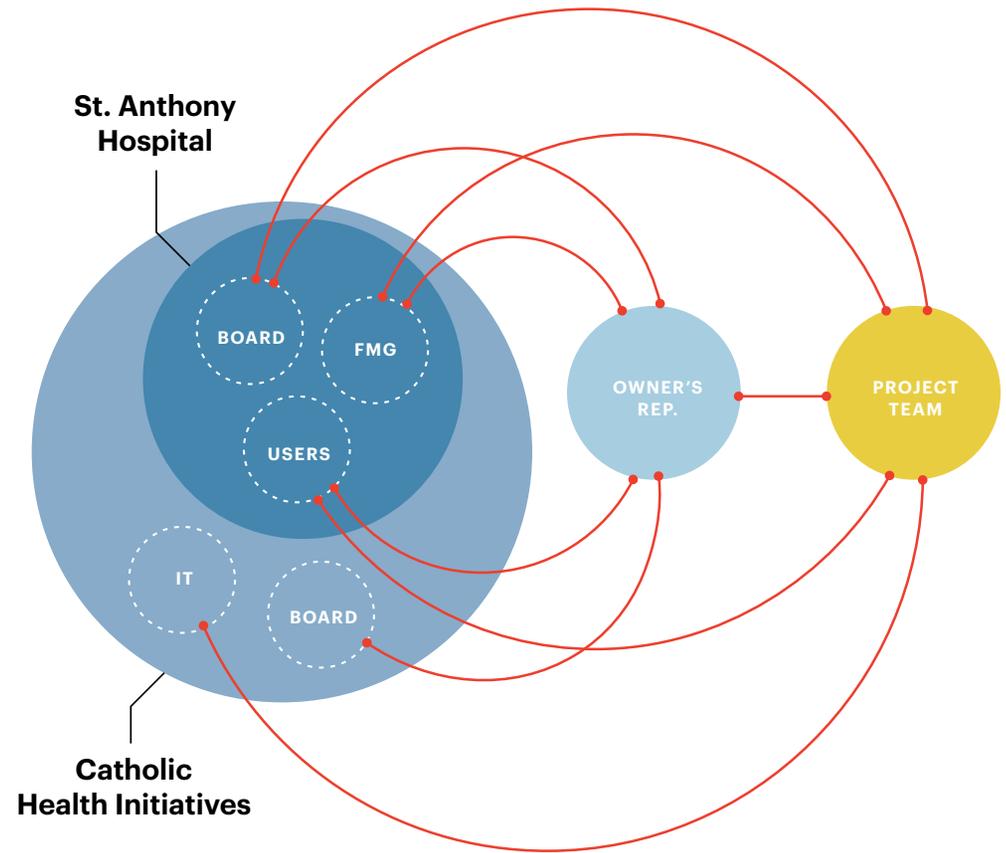
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Owner Identity & Interface

The owner was composed of multiple entities: CHI, which represented the funding and regulatory group; St. Anthony Hospital board members; the owner's representative and his subcontracted construction manager; St. Anthony Hospital administration; and St. Anthony Hospital staff. The current CFO and interim CEO of St. Anthony Hospital was involved in the late stages of the project. Over the course of the design and construction, St. Anthony Hospital experienced four different CEOs. Turnover was instigated by the CHI group, which felt that the St. Anthony Hospital CEOs were not matching their needs or the needs of the hospital. In the eyes of the St. Anthony Hospital board, "If it would not have been for the bonds within the board, and our wishes, this project probably wouldn't have gone as well or wouldn't have gotten done at all."

The St. Anthony Hospital board was made up of eleven members, and all of them were invested in the project. The St. Anthony Hospital board was an unusually engaged group of volunteers, who took it upon themselves to become educated about IPD by attending national conferences. They held a monthly two-hour dinner meeting. High levels of attendance and effective agenda planning meant that only a few additional special meetings were required over the course of planning and construction.



KEY
FMG: Facilities Management Group
IT: Information Technology

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Choosing IPD & Lean

The advisory board was unique in its extremely high level of commitment to the project and the prominent roles of its members in the community. Some members had experience as building owners and some did not. Some had attended conference presentations on Lean and integrated project delivery (IPD), and the story of Virginia Mason Hospital (a well known early IPD and Lean success story) resonated, but they were unsure how it would work in the design-and-construction process of their project. A board member with previous experience as a building owner said, “I did not know how it would really work during the construction phase with the architect and the contractor. Every building project I’ve been on, the cost overruns have always been 20% over what you thought it would be. They claimed, if you do IPD and Lean right, you won’t have that. That intrigued me, but the human part of it as well—get them out of the silos so that everybody can work together in the same direction.” Based on what they had heard from conferences and discussions with the owner’s representative, the board was interested in using Lean and IPD to maximize the value delivered on the budget rather than deliver the hospital for the lowest first cost.

The owner’s representative, based out of Portland, Oregon, was originally hired by Catholic Health Initiatives (CHI) to assess the existing hospital and the capacity for a replacement hospital. After the project was approved, he was hired as the owner’s representative, primarily working with the St. Anthony Hospital (SAH) board but coordinating with CHI. The owner’s representative was an advocate for using IPD on the project. He had worked on a successful IPD project previously with several members of the contractor and architecture companies that were selected for this project. He viewed IPD as preferable to design-build on hospital projects, especially for one of this scope and program. “I view design-build as

effective when I know what the specifications are. Where hospitals fail is when they use design-build on projects that they don’t have design specs for, which leads to change orders. When it comes to hospital work, there are a lot more opinions and moving around of pieces.”

The owner’s representative spent many hours educating the board about how IPD would work for their hospital. The owner’s representative said, “The board members were all really smart, dedicated people, but they don’t normally build buildings. They’re ranchers and farmers and accountants.” The contractor found the board to be “open-minded, progressive, interested. Anything in the way of the integrated delivery that the owner’s representative, Sellen [Construction], and ZGF [Architects] brought to them was met with open arms. They were great as far as their role in the project.” After they were convinced about IPD’s value, the owner’s representative recommended IPD to CHI. It was somewhat difficult to convince some of the individuals within the CHI owner group to use IPD for the project. The owner’s representative recalled hearing from them: “Wait a minute, you are creating incentives, but shouldn’t people behave like this anyway?” He saw that the owner was concerned that by creating the risk/reward pool they could be adding potential payouts that would exceed the budget. To help them understand that the reward pool was only distributed if the team met project goals, including the budget, he clarified the relationship between the building cost and the reward pool. He recalls clarifying the typical IPD financial arrangement, often referenced as “the deal,” to the CHI owner. In the deal, cost plus profit together would not exceed the total project budget, and in the worst-case scenario, if costs exceeded what was anticipated, profit would be reduced: “All we did was cut out some of that [reward pool from] within the budget and

said, ‘Okay, worst case is you’re still going to be at this [dollar amount for cost].’”

From the architect’s perspective, the reason for choosing IPD on the project was to “build that spirit of a team and the commitment of everybody toward the same goal.” Also, they perceived that the owner’s attorney group was the most difficult to buy in to IPD: “It’s not unusual for many clients to have their attorneys and their insurance companies saying, ‘What are you doing? You can’t do this.’”

Most of the project team members had at least one previous or concurrent IPD experience; there was one IPD project on which several team members had participated. Though the architect viewed their typical approach as collaborative, this was the first IPD project fully led and facilitated by them. The contractor had done many collaborative projects; they had recently completed a project that, though larger, had a similarly structured integrated agreement. That previous experience reduced the novelty of IPD: “Some of what may have otherwise stood out as a greater contrast or changing of behavior may have been a little bit lost on me because it was an ingrained baseline expectation from having done it before.”

- St. Anthony Hospital’s advisory board, made of volunteers who were leaders in the community, educated themselves on integrated project delivery (IPD) and believed it could work.
- The owner’s representative had been interested in IPD, particularly for health care projects.
- The Catholic Health Initiatives owner group had to be persuaded to try IPD.

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WEKIVA SPRINGS CENTER EXPANSION

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Team Selection

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The executive responsible for the district that included St. Anthony Hospital asked the owner's representative—with whom the executive and the CHI board had an existing relationship of about eight years—to act on behalf of CHI to assess the existing building and meet with St. Anthony Hospital board members. The representative and his construction manager put together a proposal for a new building. After the proposal was approved by the CHI board, they competed and were awarded the project, becoming the first team member to be selected.

The owner's representative had primary responsibility in team selection. He invited several architects to submit fee proposals for the work, plus projected fee amounts for hypothetical subconsultants. Firms were interviewed and completed facilities were toured by the owner group. After ZGF was selected, the owner's representative asked them and the head of St. Anthony Hospital facilities to select the major subconsultants through an intensive interview process. The owner's representative explained: "Even though those subcontractor firms weren't specifically a part of the IPD process, we did hand pick the people we [would be] working with. The biggest issue when you set up any team is who the people are, not who the companies are." Selected individuals were connected to the local community and a network of regional firms, seeding the team's culture with several strong pre-existing relationships.

The selected architect was required by contract to provide co-location in their office during the design process. They had offices in Portland and Seattle and chose Seattle as the base for the co-location since the design team was located there. Because the local contractors were too small to handle a large hospital construction, the owner's representative

knew the contractor would have to come from the larger metro areas of Portland, Seattle, or Boise. The chosen contractor, Sellen Construction, typically does work in the Puget Sound region, which is relatively far from Pendleton. They became interested in the project, even though it was outside their normal geographic region, because of their proximity to and familiarity with the Seattle-based architect, ZGF Architects, and a track record of performing work for CHI in Puget Sound. They explained, "When ZGF Seattle was selected, collaboration and all of the obvious efficiencies were apparent." The architect was not involved in selecting the contractor, but their strong relationship to Sellen was an important factor for the owner's representative.

Lean and IPD experience was a factor in selecting the architect, contractor, and consultants, but the overall focus remained on the individuals on the team. When the selection committee decided on a company they believed would meet the project need, confirmed team members would spend a day at the company's office and at one of their active project sites. These visits were intended to go beyond the marketing hype inherent to proposals in order to really get to know the individuals who would be on the project. The owner's representative sees that this level of care in team selection has led to a big payoff on this project: "We had the luxury of selecting the firms and the individuals we were going to work with, and we knew who they were and had experience with them before. We had a level of communication and trust right off the bat that a lot of projects wouldn't have had. Other projects where you were dealing with firms you didn't know, IPD would have a lot more benefit, whereas in our case, we were already stepped up to a level that IPD would have helped us reach if we hadn't already been there."

Even though the owner's representative was aware that for this close-knit community, working on the hospital was very meaningful, he was concerned that some of the local subs were not big enough or not qualified for the level of work required for a cutting-edge medical facility. The contractor noted, "It was a very short list of local subcontractors capable of performing on the job." However, for some trades such as HVAC, the St. Anthony Hospital facilities manager made a persuasive case that the local firm, while less experienced than others, would be available after the project was completed.

- The owner's representative was chosen by CHI and led in building the project team.
- Each company was asked to name two individuals to work on the project and to nominate individuals from other companies with whom they enjoyed working.
- Daylong site visits were intended to go beyond the marketing hype inherent to request for proposal responses.
- The hospital was a prominent part of the tight-knit ranching community. The advisory board and the owner's representative saw the benefit of using local subcontractors but balanced this with the need for high-level expertise.

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Developing Contract

Contract Type: Custom by Catholic Health Initiatives counsel using standard two-party agreements with an IPD rider-joining owner, program manager (owner’s representative), architect, and contractor

The contract borrowed some of its language from the IPD contract used by a large health-systems group, Swedish Medical Center. The architect considers the contract to be a two-party agreement, with an IPD rider: “From a technical perspective, I wouldn’t call it an integrated contract. It is two separate contracts that we agree to by a joining agreement, which addresses shared incentives to perform in a certain manner.”

The contractor contributed a contract exhibit from another IPD project that listed things that would affect the cost of a project and that should be IPD-related. The clarification of how to assign costs to the profit pool or owner contingency was very helpful and was incorporated into the agreement.

The owner determined that the risk/reward pool would be based on the construction change-order contingency and set the percentages as 60% going to the owner, 20% to the contractor, 15% to the architect, and 5% to the owner’s representative. An IPD-contingency matrix defined what type of expenditures fell within appropriate use of IPD contingency.

The owner, CHI, typically uses a nonstandard contract, using their own language and scope, and was resistant to changing their practice for this project. The owner’s representative believed the project agreement was limited by the conservatism of the owner’s attorney, resulting in what the team internally called IPD-lite. He described the process: “The owner’s attorneys insisted that they write the contracts. Since they were not that familiar with IPD, they dialed it

down to a level of reward for the team that didn’t allow involvement of consultants or subcontractors.” The architect has had this experience with owner on other projects and is looking to change a little bit of the language each time. They also plan to push harder on the next project. “They have a lot of scope items in there that don’t necessarily apply to every project, but they don’t want you to strike them. We end up having to swallow hard and leave it in.” This was “in line with previous, similar health care joining agreement deliveries” the contractor had done with other owners. They considered the agreement to be a conventional agreement, and characterized it as “IPD-ish.”

The owner’s representative negotiated their agreement with CHI through the Franciscan Health System in Tacoma, which was tasked by CHI to oversee the project. Their fee for the hospital was separate from (and lower than) the fee from the medical office building attached to the hospital. The levels of fees were different, but the owner’s representative considered the fees for two projects added together were sufficient to cover the demands related to both projects.

- The contractor provided guidance on how to assign costs, either to the profit pool or owner’s contingency. This was incorporated into the agreement.
- CHI’s attorney limited the degree to which the agreement embraced IPD.
- The core team would have preferred a more “pure” IPD with more parties involved in the agreement and risk/reward pool.

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Developing Parties

Because of CHI's reservations about IPD, they were resistant to expanding the IPD agreement to include companies other than the owner's representative, contractor, and architect. Although the team would have liked to have included other companies in the risk/reward pool, the owner, advised by their legal counsel, was firm in their decision to limit the participants to the core group. The advisory board was shown what the normal range was for the percentages of savings to be shared with stakeholders, and they approved the distribution.

- The risk/reward pool was defined as any unallocated funds from the construction contingency.
- The agreement spelled out the distribution of these funds: 60% to owner, 20% to contractor, 15% to architect, and 5% to owner's representative.
- CHI attorneys were resistant to IPD and did not want to consider adding any parties to the agreement other than the owner's representative, contractor, and architect.

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Champions

The owner’s representative was seen as the champion for IPD on the project. The original championing of the IPD came from a core group of St. Anthony Hospital board members who were strongly influenced by national conference presentations they attended. The board viewed the owner’s representative as “someone of quality” that they related to well and who understood their needs. There was a high level of trust between the board and the owner’s representative.

The board was heavily involved in the project. According to one board member, “It was a lot of time, it was a labor of love for us, for our community.” The board members invested their own time in the project and reflected that their time investment was “the penny that you spend up front that you saves you the dollar at the end.”

The hospital hired a Lean consultant to determine the current state of operations, with the goal of transforming to a Lean hospital. Work was done to examine the operational flows in several areas: tracking the patient experience, staff experience, and supply chain. The architect’s team joined midway through this process, bringing in their Lean health care planning expertise. All these efforts contributed to the programming that reduced the building footprint by 58% from the original square footage. One member of the architect’s team, trained as a nurse, was seen as instrumental to the planning process. She was the Lean health care planning leader and facilitated all of the health care planning events. Another architect team member was a champion for working with the hospital staff to integrate the cross-functional clinical teams. The architect project manager is a leader in his firm for both Lean and IPD: “I’m a champion in our office for both; I believe in both of them. I would advocate for Lean process improvement to any client because it gets the buy-in of the

staff.” The architect’s firm had IPD experience on non–health care projects, including a school. The architect believes, “One of the reasons we got hired [for this project is] because we are familiar with [IPD]. And [in the school project, ZGF and the owner] were taking it and applying it to the academic side of things, integrating everybody in the design of their building.”

The contractor has also integrated IPD culture into their firm’s work, considering Lean and IPD as their new baseline. “We’re fans, for sure. The things on our first few IPD jobs that we were doing for the first time are now baseline requirements on all of our projects as far as pull planning and scheduling and some of those types of things.”

- The advisory board championed IPD and advocated for it effectively to the larger owner group, CHI.
- The board members volunteered their own time to engage in the project, likening their investment to the penny spent up front that saves a dollar at the end.
- The owner’s representative was seen as the champion for IPD within the project team.

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QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
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Decision Structure

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The makeup of the owner led to some complexity in decision-making. The St. Anthony Hospital board was more involved than CHI, the owner. In the words of the owner's representative: "It was not unusual even at owner-architect-contractor meetings that somebody from the board was there. They weren't meddling. They had so much ownership of it. This was their baby." The board had monthly meetings, with high attendance and effectively planned agendas that reviewed the financial status of the project and made any necessary decisions. The owner was viewed by the project team as being "very hands off" on the project. According to the owner's representative, the project could have been improved with more engagement by CHI because "there was some standardization they were trying to do in their system but they never put in [to this project]."

The architect worked hard to gather in-depth feedback from the board and members of the project team. At every meeting with the client, they would begin by explaining what they were hoping to accomplish and ended by asking the client about their perception of how the meeting went—issues, likes, and dislikes.

The project manager for the architect disliked working within silos, a situation common in health care design. "It's not easy on the design teams [with silos] because all we do is shuttle diplomacy, running back and forth between all these groups and trying to act as the interpreter. And in the end, nobody's happy." From the perspective of the owner's representative, the team tried to communicate "across as many boundaries" as they could.

The contractor performs many of the trades in typical projects, but the remote location of this project put them in the unique position of subcontracting 100% of the scope

of work. Therefore, they dedicated a larger number of superintendents than typical to supervise and manage the subcontractors. For most of the subcontractors, the pace of the schedule was faster than what they had experienced. The owner's representative would at times step in with the subcontractors to push them on the schedule and to articulate what it would mean if things were not completed on time.

The program of the project was a major challenge since the footprint was greatly reduced from the original hospital. Over a series of Lean health care planning meetings, the team recalled a watershed event when a project-first attitude was made apparent. Space in any medical facility is highly valued; during the planning process many reductions were made, but the square footage still exceeded the target. At a major event, the director of the emergency room offered to reduce each examination room in their area. Model behavior from a high-profile staff person showing her willingness to give up space inspired other directors to quickly follow. The architect recalled that after that, "everything started falling into place."

- The advisory board was extremely engaged in the project and "had ownership."
- CHI was a "very hands off" owner, which may have led to some missed opportunities for standardizing processes.
- Due to the remote location and the highly invested local community, the contractor chose to use more subcontractors than they do typically.
- Lean health care planning was key to decisions, especially since the program was a significant reduction from their previous facility.

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On Board & Off Board

The most significant turnover during the project was the number of CEOs for St. Anthony Hospital. There were four different people serving in the role of CEO, with tenures lasting from about three months to one-and-a-half years. The final executive was brought in as the building was being finished, and he was given the charge that he could not change anything on the project. From the St. Anthony Hospital board point of view, the previous CEOs weren't working out: "Sometimes those CEOs were not totally the board's choice, and we knew it wasn't going to work out. We did everything we could to try to help it work because in a small community, you have to be visible." Each new CEO was briefed on the project, but given the high turnover, their impact on the project team and outcomes was minimal.

Other personnel issues were easier to manage but still caused some tension. One team member commented that the collaborative culture was difficult for some people: "The problems had to do with people who weren't really into the IPD part of it. We had some trouble with IT managers and equipment [suppliers]." Two of the IT managers from CHI were not good fits. After attempts to integrate them were unsuccessful, they were asked to leave the team.

There was high turnover of the architect's staff due to staff leaving the firm or being reassigned to other projects. Over the course of the project, three different people served as the project architect. For ZGF's project manager, "People coming on and off the project is always inefficient because then they have to become reorientated to all the issues." When new designers were added to the team, Lean health care experience was prioritized over IPD experience. Other team members believed that the continuity of the project manager

and his proactive on-boarding process for his personnel overcame any challenges of the changes to design personnel.

When the contractor brought on people to their team, they chose individuals who were familiar with both IPD and with health care.

- The hospital experienced high turnover of CEOs during the project; the advisory board provided continuity.
- IT managers from CHI did not fit well with the project team culture and were asked to leave.
- Due to economic factors, there were several personnel changes for the architect, but the team believed these did not negatively affect the project.

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Clarity of Goals

The hospital was described by the advisory board as their “dream” of having high-quality health care in their small community. In the words of one board member: “One of my goals was to make sure I didn’t wake up here one morning and find out that our closest hospital was thirty, forty miles away from us.”

The board members traveled to national meetings to educate themselves on hospital facilities and ended up being involved, as they put it, in the “cosmetic stuff too.” They traveled to visit recently completed hospital projects with the architect and owner’s representative, with the goal of gaining an understanding of what was possible for their scope and budget. They were interested in the facilities that felt less sterile and looked less like a hospital, and in giving the patient a soothing experience. “Sometimes you don’t know it until you see it or feel it, but then you know it.” The owner’s representative considered these early trips highly beneficial: “It bonded our group, our selection group, with the board members. We’re in downtown Seattle, we’re traveling together, and we really all locked arms.” The owner’s representative worked with the board early on in the process to draw out and put in writing guiding principles based on their vision, including the hospital having a special place in the community and breaking down the silos of how the hospital staff currently operated.

The architect’s first formal meeting with the client was a two-day visioning session, which included hospital leadership, the board, and clinical staff. At the end of the meeting, they collectively developed a description of their shared values, what became known as the “patient is king” motto adopted by the hospital staff.

The owner’s representative had developed a template dashboard for CHI that included key metrics to track for all projects and used it on this project. He believed the goals of the CHI owner were “really simple”: “Besides the dashboard, it was just delivering on time and on schedule on a budget, and we were obsessed with it.” The rep had a monthly call with the CHI owners, and as long as things were on schedule and budget, the owner said, “We’re good.” The team had the sense that the owner did not fully understand the benefits of IPD. According to the owner’s representative construction manager, “I don’t think they really viewed it any differently than they would have a traditional project. They never really stated goals. I didn’t feel like the goals on the project were really any different than on any other project.” And yet, the team sensed that the owner was positive about IPD, and CHI has used it again on another project.

The team also made the commitment to maximize local subcontractor and supplier participation, and the owner established targets for female- and minority-owned business enterprises. According to the contractor, “It was a sincere commitment, and we worked hard to do that.”

Compared to other Lean and IPD projects, the owner’s representative considered the project to be somewhat “softer” in terms of metrics. Though less common metrics, such as tracking employee turnover, were discussed, they were not used. With some health care clients, the architect has seen that they measure everything, but this has not been that the case with this client: “When we ask, ‘Can you give us your current state metrics?’ they don’t know how to measure them. So it’s hard for us to measure when we don’t have the right baseline. They don’t want to invest in building the

baseline.” For the contractor as well, the owner was not much involved on the construction side in terms of owner-driven metrics.

- The advisory board was committed to the “dream” of a high-quality health care facility in their small community.
- The new facility was less than half the size of the previous, outdated hospital, and the need for greatly increased efficiency was clearly communicated to all stakeholders.
- The board attended national conferences on Lean and IPD and visited facilities to determine the outcomes they wanted for the project team and the project.
- In an intensive visioning session led by the architect, the board and hospital leadership and staff came up with the guiding value that “the patient is king.”
- CHI’s goals were tracked on a standardized dashboard developed and managed by the project manager.

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Resources & Facilitation

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The advisory board attended Estes Park, a national medical conference, at which they received the majority of their training in Lean. Three months before the architect was brought on board, the owner’s rep hired Lean Healthcare West out of Missoula, Montana, for Lean education for the hospital staff and to document a baseline of current state of operations. The owner’s representative spoke with others doing IPD projects in the region and informally with an IPD consultant. The owner’s rep had experience in Lean but mostly for health care operations.

After the architect was brought on board, they began to attend the Lean Healthcare West meetings. The architect had significant expertise in Lean health care planning, with dedicated Lean experts within the firm and members of the team having gone through training. In their first meetings, the architects played a participant role, letting the Lean consultant from Lean Healthcare West take the lead. During a two-month overlap, the Lean information was transferred to the architect’s in-house Lean expert, and the architects took the lead in the Lean health care planning. At the initial meetings, the owner’s rep was adamant that the architect not create any drawings: “I said, ‘Okay, you guys can come to some of these meetings, but you don’t draw anything. Nothing gets drawn, this is not about future.’ I want these guys to have the discipline to think through what do we do, what do we actually do, and pick that apart.” He recalled that the architects “could barely stand it. They wanted to pick up a pen and start saying, ‘What about...’” Team members and hospital staff believed this early planning time was extremely valuable and created a strong platform for the start of design.

The architect characterizes the IPD process in this project as “organic.” The hospital’s executive team met weekly at

the beginning of the project to develop “the overall ground rules.” The executive team organized and participated in the major design-consultant and subcontractor selections. A kick-off meeting was held with the integrated design team, composed of construction managers, the facilities director, the contractor, architects, and design engineers, to review the IPD process. Regular two-day team meetings occurred on a biweekly basis, usually at the architect’s office. Seven four-day Lean events occurred in Pendleton on a monthly basis. Monthly project report-outs to the board occurred throughout the project. The executive team met formally on a roughly monthly basis (or as needed) to check in on overall IPD team performance.

One of the hospital staff—working in supply chain—most resistant to using Lean processes for his work was sent to Tacoma to spend a week with his counterpart at another hospital to show him what they do and how it was different. Even though the owner’s representative thought the experience helped, he saw that the change overwhelmed the staff person and generated anxiety: “It was a fear of change to the point where he would visibly shake, and I hadn’t quite seen it to that degree. But the interesting thing was that we didn’t throw him out. We didn’t try to take him out. We’d actually tried to be supportive of him and tried to get help.” The staff person is now a vocal champion of Lean and strongly supports the changes made to the system he operates.

- The advisory board members attended a national Lean training.
- The owner’s representative hired a Lean health care planner to work with hospital staff to develop a baseline. Later, the architect had in-house Lean experts run sessions with the staff.
- The core team had limited IPD training.

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Tools & Processes

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In the old facility, medical units were located relatively far from one another, and circulation was circuitous. Over time, the fragmentation of the spaces reinforced a siloed culture, and the advisory board prioritized changing that culture. Through their investigations and training in Lean health care planning, they determined that Lean could be effective in bringing about that shift. The Lean consultants worked intently with the hospital staff to educate them on Lean practices regarding space needs and operation, but since Lean was not integral to the organization, the process was not smooth. The architect brought board members to a mock-up layout they were doing for another hospital, and it sold the board on the idea of mock-ups to support Lean planning. The board appreciated how the mock-up informed decision-makers on the end-user perspective: "It got the people talking to each other. They negotiated and explained their position—why they needed certain things—to the other departments, and everybody started working together. It was an amazing process." As the architect described, "We found that the Lean processes helped us with the tools, not only BIM but also the mock-ups. The clinical staff is not trained to read drawings or understand spatial relationships like an architect is. But we're not trained to read a medical chart or an X-ray. So the thought that we can do their business is kind of foolish. So this process allows them to maximize what they do well, and we can be there with them to help form the architecture around that and sculpt it in a way that functions well and looks good."

The team believed there were parallels between the Lean-programming process and use of Lean in solving construction issues. For example, a local site-work and utility subcontractor happened to own land across the highway from the project site, and in his base proposal he offered to process gravel off

of his property and then use a conveyor belt through a culvert under the road to bring the material to the site. This way, the road did not have to be shut down. The approach offered a huge savings for the job and a competitive advantage for the subcontractor.

The architect believed that Lean health care planning takes more effort on the part of designers because documentation and feedback needs to be completed and turned around quickly. Based on their experience with this and other Lean-planning projects, they have changed their business practice to charge separately for Lean facilitation, which also covers the need for fast response times. They believe this approach has worked well for their clients since the architect charges only one-third of the cost of Lean consultants. For the architect, this has taken the place of programming services that they might have provided under traditional delivery. On the St. Anthony Hospital project, the architect assigned a dedicated Lean facilitator from their office, and the additional personnel helped the designers focus on their tasks. The project manager didn't originally budget for this but believed it was necessary, and it gave the designers the opportunity to gain more expertise and invest in Lean. Even so, the architect finds the application of Lean to the design process difficult: "That's a big discussion for us. Can we take a very iterative discovery process and Lean it up so it's a little more efficient? Probably. While we haven't figured it out, we are working on it."

ZGF has developed a tool for tracking the timing of decision-making. It is similar to pull planning but graphically breaks down the tasks into weekly forecasts by area. The project manager used it for this project initially, finding it visually interesting, but eventually stopped because it was "just too much work."

The project team used a dashboard based upon the CHI template, which was originally developed for them by the owner's representative on Pendleton and adopted for all CHI projects. The owner's representative showed the dashboard to the board early on to see if they wanted anything additional included and kept it up to date, prioritizing red-line items. The board did not have any changes, and the template has since been adopted by CHI for all their capital projects. From the contractor's perspective, the dashboard was a reporting tool for the owner that was used by the owner's rep to wrap up the meetings and, unless there was a critical variance, was only discussed briefly.

To get the full benefit of their collaborative-work plans, the team photo-documented their work and translated it into targets, goals, and deliverables. The owner's representative commented that the board appreciated seeing the full calendar: "It's funny to me how with a new client, I can put a big calendar on the wall and start working and at the end go, 'God, that was great.' It is really not that hard."

- The majority of the Lean processes on this project were related to Lean health care planning and operations lead by the architect.
- The project team used a dashboard that had been developed by the owner's representative for CHI.

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Lean Effectiveness

Overall, the team reports very limited use of Lean construction tools. Something similar to Plus/Delta was used. “It was the owner side that looked at end-user satisfaction and some of those kinds of early goal setting. We were sort of on the periphery of that and had little of that with our subs.” The team somewhat utilized Last Planner System, and the contractor regarded their use of Last Planner as 60% effective.

The owner’s representative uses pull planning often for things like transition planning and education training. “We’d take up a whole wall, and we start at the end and go backward.” The contractor had a superintendent with a lot of experience in Lean construction tools who facilitated some of the subcontractor pull planning meetings. Even so, they had difficulty with the subs who were skeptical of the pull planning process. “They did it because we made them do it, but obviously, the success of a pull planning meeting is 100% contingent on the participation of the subcontractors and then getting up and doing it.” In addition to pull planning, they also saw that other collaborative practices were new to many of the subcontractors: “Where we met some resistance or struggled with IPD was with some of the subcontractors who were just old school: hard bid, plan, spec. ‘If it’s not in the drawings, we don’t have it.’ Not interested in attending pull planning meetings, not interested in the weekly planner process.” The contractor did not remove any subcontractors, but there were some he never considered as really being on the team. “I think they were concerned that they were somehow creating risk or liability for themselves by making a commitment that they couldn’t meet, and there was just general stubbornness and obstinacy. We had to communicate that committing to having that done and then not having it done isn’t going to be catastrophic for you” but that the

commitments helped with the planning. The team did less with pull planning on the design side. The architect did not participate in the construction pull planning but received updates at the weekly construction meetings.

During construction, every subcontractor was required to have a representative at the daily huddle during which they would review the day’s schedule on-site and walk the project to see where things would be happening. For the contractor, the daily huddle was “the one piece of the overall weekly planner process that subs were most consistently bought into and saw the most value from.”

- The team found visual documentation helpful and used it for pull planning and general scheduling.
- Some local subcontractors resisted pull planning and did not full engage.
- Daily huddles were effective.

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BIM

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The team did not co-locate in the typical sense. The architect was required by contract to host co-location in their Seattle office. This worked well for both Sellen and ZGF, which were Seattle based. There was also frequent travel to the site where informal co-locations occurred. The early Lean meetings, open houses for staff and for the public, and some of the regular group meetings took place in an old house in Pendleton, rented by the owner's representative and made available to all team members. As described by the architect: "We would come once a month for the events, and I would come down once every other week sometimes for just a day. There was the spirit to the co-location because we did the events together, we lived together, we socialized at night. We also got invited to advisory board members' houses for dinner or a bonfire." The house and socializing was seen as a way of bringing people into the group. Also, even during social time, work would get done through conversation. At the point when the team grew to include subcontractors, the team was no longer renting the house. Collaborative work on-site shifted to trailers as versions of a Big Room. Meetings in Pendleton were held every week or two, typically included the owner's representatives, contractors, architects, and project managers from Seattle, who would often carpool for the four-and-half-hour drive.

The team did not use a coordinated BIM on the project. The owner's representative did not push the full employment of BIM. The architect and structural engineer used Revit; the engineers used AutoCAD. A St. Anthony Hospital staff member from the facilities-planning group built Sketch-Up models for some of the facility support areas—ZGF was able to use those models to develop some of the spaces.

ZGF put a large emphasis on updating the model after each of the design sessions with hospital staff. The sessions included full-size mock-ups, detailed to the level of the placement of switches and plugs. During the sessions, participants used sticky notes to mark up the mock-up. In some cases the changes were made to the BIM in real time, and the revised model was made available very shortly after each design session to finalize the decisions.

- Use of BIM was limited to coordination between the architect and structural engineer.
- A facilities manager for the hospital was proficient in basic 3-D modeling and created models of the facility support areas, which were incorporated into the final model by the architect.

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Workplace

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AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE

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T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

The team had a dedicated meeting room at the architect's Seattle office for six months. The team would have weekly all-day integrative design meetings at the architect's office that would sometimes last two days, with the first day for meetings and the second for collaborative work sessions. The team also had integrated weeklong design events in Pendleton. They found with both that time was needed during the process to break out and deal with information, beforehand to prepare, and after for assimilation.

Co-locating within the architect's office was somewhat of a challenge for the architect. With team members who are not 100% dedicated to the project, the client would find it difficult seeing them working on other projects. Furthermore, there are confidentiality issues with the client seeing the work of competing clients, and the architect would need to move project teams to another floor within the building: "Having the clients sit in your office with you can be informative, but you also feel a little guarded like, 'Oh, he's learning too much here.' And that's true with the design consultants and the contractors. [Co-locating] in our office, although we do it occasionally, is a challenge from our perspective."

The team would pull together at the architect's office at pods next to a team space with pin-up walls and a conference table. "Everything was always pinned up, and it's just left up and updated all the time. We'd take down all the [older] information, put up the most current information." The owner's representative would drive from Portland to Seattle to spend three days a week in the architect's office and had a workstation there.

The owner's representative sensed that some of the people, who did not feel the topic areas fell within their scope, were not fully engaged in the design meetings within the weekly

team meetings. "Whether you're on the agenda or not, you are there and you're participating in this conversation. And I think that makes some people uncomfortable." Overall, most team members believed that the Seattle-based formal co-location and the Pendleton-based informal co-location worked well for them. Given the remote location of the site and the proximity of team members in the two urban locations, the split strategy worked well.

ZGF found mock-ups very effective as part of the Lean health care planning process. The team had access to a large work space and worked with the hospital staff to create extensive mock-ups, testing their program and space requirements. Sticky notes were translated into notes and changes were made to the model, often in real time. Many members of the advisory board attended these sessions and believed their participation helped support the drastic square footage reductions each hospital area had to address. One of the board members said, "We weren't sitting in a room saying, 'You've got to do this. This is great. You guys will love it.' We were right there with them, and we sat through the sessions."

- Due to the remote site and relatively small size of the project, the team could not use full-time co-location. Since the architect and contractor were both based in Seattle, the entire core team used the architect's office for early stage co-location.
- The owner's representative rented a large house near the site for later co-location for formal and informal interactions.
- During construction, the team met in job-site trailers approximately every other week.
- The team worked with the hospital staff to create extensive mock-ups to test program and space requirements.

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
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Team Alignment

The team understood the owner’s goal was to have the best quality outcome within the budget, and they managed the owner’s contingency with the intent to spend it strategically and completely. By contrast, they managed the team contingency with the goal of preserving as much as possible, with the savings being shared at the end.

For the owner’s representative, the effect of the financial incentive was minimal. “I think that the risk/reward pool was not large enough to really affect people’s behavior that much. The contractor paid attention to it, but in my experience, the contractor is always much more dollar sensitive than the design team members. I think everybody worked in the owner’s best interests. I don’t think it really changed people’s behavior particularly, except that we went out of our way to have the key members in the IPD team: the lead architect and several people from the contractor.”

On the other hand, the contractor believed that it radically changed behavior for everyone on the team: “I would say that the joining agreement and the IPD concepts absolutely changed behavior on both the design-team and the construction sides.”

- The owner’s representative thought the financial incentive had a minimal impact on the team since the dollar amounts were low.
- Regardless of the financial motivation, the owner’s representative believed that the joining agreement and IPD concepts “absolutely changed behavior.”

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Collaboration

There was significant collaborative budget management on the project, and target budgeting was viewed by the team as highly beneficial. The contractor saw the benefit of the IPD process in their ability to work with the architect early to assess the pricing of design options, which allowed them to stay in step throughout the project: “[The IPD agreement] was executed very early on when the architect had material boards and really rough renderings. We went through those iterations before they were really detailed and they had gone too far down the road in design, so they didn’t blow their design budget and then have to go back to square one.” The contractor attributed this close working relationship with the design team to the shared financial incentives: “It changes it from just being a VE [value engineering] effort, or it reduces our struggles in establishing target value design budget buckets, designed to budget, because they’ve got skin in the game. Whereas if it’s negotiated and we’re all on board early, there may be more of a struggle with the design team in getting them to understand what the owner’s budget affords.” This was particularly beneficial in the design of the building profile and exterior systems. The architect saw a fair amount of push and pull—for example, the slate material for cladding was expensive, but the architect, effectively, made the case to the contractor that it was the cheaper option since they had used it previously and knew it would provide a labor savings.

The shared and transparent management of the contingency was a positive factor. The team recalled examples of it relieving pressure during construction. For example, with a mechanical issue, the attitude toward it was: “We just need to make it right and do whatever it takes to make this function the way it’s supposed to. Then later we’ll wrestle with where the money comes from.” The team prioritized using the owner’s contingency to add value to the project and

tracked several expenses that could be approved later in the project after other expenses were known. The rep kept a large spreadsheet that tracked each change order and how it was split between the two contingencies (owner’s and project’s), and he met with the owner, hospital CFO, architect, and contractor each month to review. The owner had the last word on how they were split, but in general the team believed the decisions were transparent and equitable.

In early design, the team established target budgets and kept each segment of the project within their budgets. As the team worked through areas of potential budget savings, they created formal add alternates that would be ready to add back if they saw budget relief somewhere else in the project. An add-alternate design package was maintained to keep pricing current, and later in design, when the budget allowed, the advisory board voted on which items to add back.

One example of budget savings was the site work. As noted by the contractor: “Because of the large size of that site, early on the landscaping budget was high. Collectively the group said, ‘Let’s scale back the areas of enhanced landscaping. Let’s return a good portion of the site to its native grasses and reallocate some of those dollars to mechanical or to wherever.’”

Late in the project, a \$100,000 water feature that had been placed on the add-back list was approved, fulfilling a high-priority wish-list item for the board. There were other items the team was able to put back into the project, but the architect also recalled areas of compromise: “There was one section that we didn’t buy back that I wish we had. It’s done. We’ve got to move on. It’s hard to ask an architect what we gave up because in our minds we gave up a lot. But in the end, when you look back, it worked fine.”

The first change order on the project was issued to correct a problem with the patient-room bathtubs. When the approved fixture arrived on-site, the hospital nursing staff realized they were too short to meet their needs. The team had worked without formal change orders until this point, and the change-order process had not been implemented. St. Anthony Hospital’s CEO signed off on the approximately \$80,000 change presented by the owner’s representative, but there wasn’t a collective conversation with the board about how to manage change orders or at what threshold. The board felt that it should have gone through their committee, which included the contractor and architect. Tension around this issue led to a decrease in trust, but afterward there was more direct contact “to make sure everything was going right,” according to the board.

The team worked to minimize requests for information (RFIs). While they were successful, the architect felt that the low number RFIs came at the cost of a large volume of email.

- The architect and contractor worked together effectively to design to budget.
- Increasing hospital efficiency was paramount, and all stakeholders aligned around that goal.
- Shared management of the contingency promoted collaboration and relieved tension when things turned out differently than planned.
- Miscommunication around a change order reduced trust between the project team and the advisory board, but new processes were put in place that improved communication.

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Team Culture

The team believed that several factors set the foundation for them to function at a high level from the beginning of the project. Prior working relationships, as well as similar corporate cultures and expectations, were major contributing factors. The team socialized frequently during the project, having drinks and dinners together outside of work hours.

Early in the design phase—during the Lean health care planning—the design team led an exercise using a string, which was used to mark out different pathways through the old hospital and the design options under consideration. The string exercise allowed the health care staff to test adjacencies, material management, and travel distances. The contractor provided cost estimates for the schemes.

The team didn't formally measure their performance. As described by the architect: "We discussed it and actually went through a couple of reviews on how to set up metrics and how to measure them on a monthly basis to see how we're performing. We just never actually needed them." Other than schedule milestones, there were no specific team metrics.

The owner's representative described the working relationships: "It didn't feel like you're working that hard because you were with people that you knew and you trusted, and people were doing what they're supposed to do. And the team dynamic was such that people would check in on somebody if they were not doing so well." Team members took turns leading meetings, and generally team members believed their working relationships were very positive.

In general, several team members believed that they would have seen benefit from a more contractually "pure" IPD if this had been a larger project with full team involvement. Compared to this relatively small project, the owner's

representative felt that IPD was more effective on larger projects where the teams could dedicate people full time and be co-located. In this case, with a small project in a remote location, "the contract limited the pool. It automatically limited the degree to which other people on the team could have been involved, so subconsultants and subcontractors weren't involved. That affected their behavior in terms of wanting to spend more time working in the architect's office during design, [the office] was kind of an IPD environment. The project wasn't that large for a lot of these firms, and all the people working on the project were also working on other jobs—they would just have weekly meetings." "Even though we didn't have a traditional three-party agreement," the architect stated, "I think the team acted very much in an integrated manner in a lot of ways, but I think there's a possibility we could have gone further with more time or a larger project."

- The team believed their high-functioning culture could be attributed to strong existing relationships and similar corporate cultures.
- The team socialized frequently outside of work hours and reported a strong personal rapport.
- The relatively small size of the project and remote location may have limited the interaction among team members.

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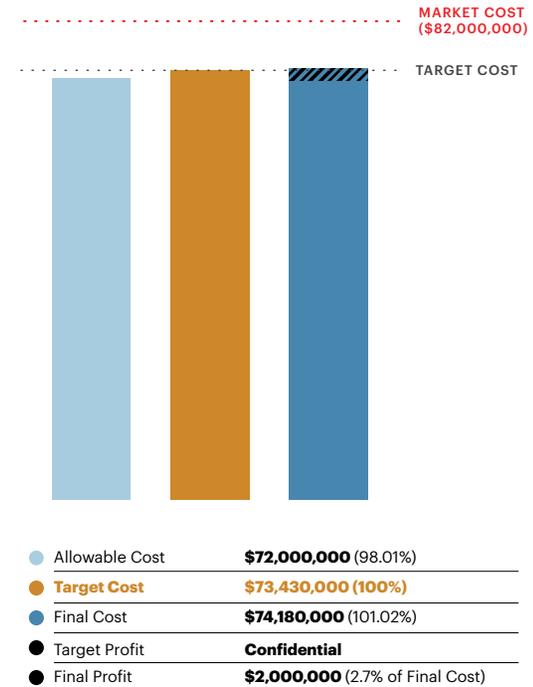
Profit & Payout

There were different perceptions about the percentage of the project contingency that was distributed as profit at the end of the project. The owner’s representative said the team had spent two-thirds of the contingency, upon which their profit was based. The contractor recalled using less than half of the contingency, with the rest of the savings being split at the end. The advisory board remembered the contingency funds as staying “pretty much intact because it was such an integrated process, including with the contractors.” Despite the differences in perception, the team felt that the contingency discussions were open book throughout the process—not contentious—and though the answer was not always black and white, it was eventually split appropriately between the owner and the IPD contingencies.

For the architect the financial incentive was not a strong motivating factor for the design team. “We champion quality design and highly functional buildings, that’s important to us. And my challenge is getting my team to stop overembellishing things, balancing design and budget.” In contrast, he believed that the behavior of the contractor and owner’s representative was positively affected by the financial incentive. The architect and the mechanical engineer, overall, did not make money on the project, and the incentive funds played an important role in offsetting some of the intangible costs of the project for their firms. If the full-incentive fee had been paid out, the architect’s costs would have been covered. Other factors for the architect included lower fees due to the market at that time, personnel changes, and additional Lean support. The architect summed it up: “If you took our lost profit and what we lost in fee, it was a lot. But it was at a certain time in the marketplace, and it was a commitment to this client, our relationship to our client. Travel is the hard part because you lose days in travel, and it’s hard to account

for that.” He concludes with an observation of the value of the project to the firm: “It was an opportunity to train some staff in a whole new way of delivery.”

- There were differing perceptions among the team regarding the amount of contingency remaining at the end of the project, but everyone agreed that the management during the project was transparent.
- The architect had not originally planned for the required level of Lean-planning personnel but saw the additional time as an investment for the firm.



ST. ANTHONY PROJECT COSTS AND PROFIT

The final project cost of \$74M was approximately \$750,000 over the target cost. The profit payout was approximately \$2M, almost 3% of the final project cost. The owner’s contingency was spent strategically on the project, and the team contingency was preserved for profit sharing. Schedule savings worth \$1.2M was invested in the project.

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Budget & Schedule

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The initial proposal for the project was \$82M, and this was not approved by the owner, CHI, because there were other capital projects competing for the funds. During the year waiting for the next funding cycle, the owner and owner's representative took the time learn how Lean would work for them and to understand what was happening in their current process, which "set the table for a better design process." Funding for \$72M was approved the following year, \$10M less than requested. They decided to move forward with the lower amount instead of taking the risk that the project might not be favorably reviewed in the next funding cycle. The owner's representative considered the budget to be tight and attributed that to the market circumstances at the time.

There were two contingencies on the project, one for the owner and owner-caused changes, and the other for IPD, which was related to items the team was managing.

The architect considered the fee budget and the project budget to be tight. "We went after this job in a tight market. We decided this was a project we wanted to do, so our fee was low. Financially, it was a tough battle in-house to manage." And yet, the architect tried to do what was right for the project rather than the bottom line. "We had one of the team members on the project, a registered nurse who is also a licensed architect, and we wanted to give her Lean experience, so we actually made the investment of having her being a part of this project team, even though we didn't originally envisioned her on the team, so she could learn and pick up the process and experience."

According to the board, it was a triumph to have approved funding, even if it was lower than the amount requested. "We had worked very ferociously for years to try and make sure we did things right. We took care of our people, but we made

money and we saved it, but it was in CHI's coffers. We had permission to use our money. When it was done, there was not a penny owed—that is a first for CHI. There's probably not too many hospitals have been built in the 2000s that can say that."

The original schedule presented to the design/construction team by the construction manager assumed eighteen months for construction plus three months for move in. The actual schedule was sixteen months for construction plus the three months for move in. The result was a two-month reduction in the overall schedule. Based on past projects, the board and the CHI leadership assumed a twenty-three-month construction/move-in schedule. So for the owner, the project was completed four months early. This overall schedule reduction resulted in approximately \$1.2M savings of capitalized interest. The owner's representative thought, "We could do better, but we didn't make a commitment of three months or four months and it just evolved." The board's commented, "They said that would probably happen, and they stayed right on track with everything and it worked well." The team attributed the time savings in part to updating the designs directly during the design meetings rather than taking notes and doing it afterward. The architect also attributed it to the multiple delivery packages, which allowed early and parallel work, but they were not consciously trying to reduce time on the schedule. The board met monthly to make decisions as a way to keep the project on schedule.

The schedule savings translated to a budget increase, driving \$1.2M in capital interest saved on the funding that the owner allowed the team to put back into the project.

- The project started with less funding than they had proposed, but they proceeded with the approved funding rather than wait for a new approval cycle.
- The project completed within budget, and the advisory board considers that to be a unique triumph.
- The project completed two months ahead of schedule; the team attributes the time savings to the timely and streamlined design-feedback loop and multiple delivery packages.
- Schedule savings translated into \$1.2M budget savings that was reinvested into the project.

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Building Outcomes

CHI wanted a high-performance building, though they did not want to pursue LEED because of the documentation required. The team did preliminary LEED analysis and tracked some of the points, but ultimately, energy-performance goals did not drive any decisions. There were energy use intensity targets of 180 in the contract, and the building has met or exceeded these goals, running at about 160, significantly lower than health care averages of 300–400.

PROGRAM/TENANT SATISFACTION

The owner’s representative group included a construction-management expert, who characterized the team goals as “traditional” in terms of schedule and budget but noted that the outcome “exceeded their expectations of how nice the building could be in terms of function and appearance. I don’t know what they expected exactly, but I think they were pleasantly surprised with how nicely it turned out.”

The hospital staff adopted “patient is king” as its guiding principal. St. Anthony Hospital board members noted how this motto helped to align staff with diverse agendas: “One thing in this whole process that we learned way up front is that everything was based on ‘patient is king.’ Everything is done for the patient—not for staff, not for visitors, not for the docs. This was for the patient.”

The board felt that it was important to have the staff involved in the process of design and that they knew that the facility they would be using every day was based on their choices. In retrospect, the board saw that some staff took Lean health care planning to heart, and some did not. A board member observed it was understandable that some staff was less engaged “because it’s extra time, especially for those people who work at the hospital all day and then have to come to a

meeting.” He went on to say that while some people skipped the meetings where hospital-wide issues were discussed using the mock-ups, most staff participated in the meetings directly related to their department. After the staff moved into the new building, the board saw that the staff needed more training than anticipated: “They needed a lot more training when we actually got in the building because a lot of them tried to revert back to ‘my space,’ and ‘I need another closet to hide some more stuff in.’ They were shell shocked that it was so different.” The board members planned to continue to monitor how the Lean health care operations developed as the staff used the new facility.

For the architect, IPD has become key in health care projects: “I don’t want to go back to traditional design in health care, because I don’t want to do that shuttle diplomacy between the provider, the nurse, the pharmacist, the lab, housekeeping—it’s best to have them all at the table. When you see it work, you realize how invaluable it is and you can see the playing field leveling from the eagle’s nest of the surgeon down to the person doing the daily work. That brings them all to the same platform. They realize, ‘Wow, I didn’t realize that’s what you did and how important that is.’” The board felt that the architect did a “great job” working with the staff using the Lean process to mock up the rooms and asking what was needed and wanted.

The owner’s representative and owner discussed standard metrics around space planning and looked to a similar project that had half the square footage as a place to start. According to the architect, there was some current state analysis and future state analysis about reducing walking times and similar items, but they didn’t have enough information on operational metrics to impact decisions.

- There were some energy-performance goals that have been met or exceeded, but the team did not believe they drove many decisions in the project.

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Project Credits

PROJECT TEAM

Signatory & Risk/Reward Pool

St. Anthony Hospital, Catholic Health Initiatives Group, Owner

The Healthcare Collaborative Group, Overall Project Manager/
Owner's Representative

Sellen Construction, Contractor

ZGF Architects, Architect

INTERVIEWEES

Owner Rep (Healthcare Collaborative Group)

Joe Kunkel (Independent Project Manager)

Owner Rep (Healthcare Collaborative Group)

Christopher Kirk (Owner's Representative for Construction)

Board (St. Anthony Hospital Advisory Board)

Tim Hawkins (Board Member), Jerry Simpson (Board Member)

Architect (ZGF Architects)

John Mess (Project Manager)

Contractor (Sellen Construction)

Randy Boettcher (Senior Project Manager)

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Context

Legal Commercial

Leadership & Management

Processes & Lean

Alignment & Goals

Building Outcomes



At A Glance
Project Description
Project Timeline
Owner Identity & Interface

Choosing IPD & Lean
Team Selection
Developing Contract
Developing Parties

Champions
Decision Structure
On Board & Off Board
Clarity of Goals

Resources & Facilitation
Tools & Processes
Lean Effectiveness
BIM
Workplace

Team Alignment
Collaboration
Team Culture

Profit & Payout
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Project Description

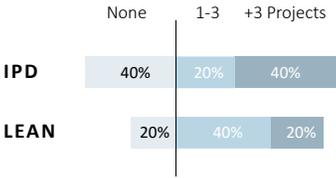
PROJECT Sutter Medical Office Building: Los Gatos
LOCATION Los Gatos, CA
BUILDING TYPE Medical Office Building
PROJECT TYPE Tenant Improvement
CONTRACT Custom
OWNER Palo Alto Medical Foundation
ARCHITECT HPS
CONTRACTOR WL Butler
PROJECT START September 2012
COMPLETION April 2015

Project Image



Photo Credit: PAMF

Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 5

Both project teams had a mix of experience in IPD and Lean, ranging from no experience to high experience. The Los Gatos team was a newer team with fewer previous working relationships.

Building Size **40,855 sq. ft.**



Budget **\$19,693,681**



Schedule **22 months design 12 months construction**



Project Description

PROJECT Sutter Medical Office Building: Sunnyvale
LOCATION Sunnyvale, CA
BUILDING TYPE Medical Office Building
PROJECT TYPE New Construction
CONTRACT Custom
OWNER Palo Alto Medical Foundation
ARCHITECT HPS
CONTRACTOR DPR
PROJECT START November 2010
COMPLETION August 2013

Project Image



Photo Credit: PAMF

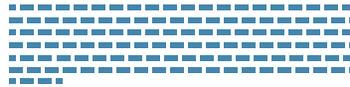
Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 7

The Sunnyvale team had several members who had worked together on one or several past projects.

Building Size **120,000 sq. ft.**



Budget **\$136,549,608**



Schedule **29 months design 28 months construction**



Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Project Description

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MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

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WEKIVA SPRINGS CENTER EXPANSION

Sutter Health is one of the nation's most experienced owners in using integrated project delivery (IPD). The Integrated Form of Agreement (IFOA), developed for Sutter by Will Lichtig, was widely shared in the industry at the time when IPD was in its very early stage of adoption in the US building industry and became an influential model contract. Several Sutter project managers are champions of IPD and have a depth of experience that allows them to understand the evolution of IPD in the health care industry.

There are two case studies included in this report, Sunnyvale and Los Gatos, both completed at roughly the same time. To discuss these cases, it is important to understand the context of a third Sutter project, El Camino, one of the first projects in the United States to model collaborative concepts, shared incentives, BIM, and prefabrication. Lessons learned from El Camino directly informed Sunnyvale and Los Gatos. All of these projects shared the same owner and are also connected by a heavy overlap in project team companies and individuals. Sunnyvale, a new construction project with a cancer-care program, started just as El Camino completed, and several of the project team firms were engaged for Sunnyvale's design and construction. The project was delayed because of entitlements and concerns about the facility's location in a residential area. Los Gatos was also new construction but was designed as a two-story mixed-use retail-and-office building built by a local developer. Sutter negotiated with the developer before construction started, and they were able to adapt the core and shell to meet their needs for a primary-care clinic. The contractor, inexperienced in IPD and Lean, was originally hired by the developer and later hired by Sutter for the build out. Although there was a great deal of continuity between the three projects, the experience level of the team

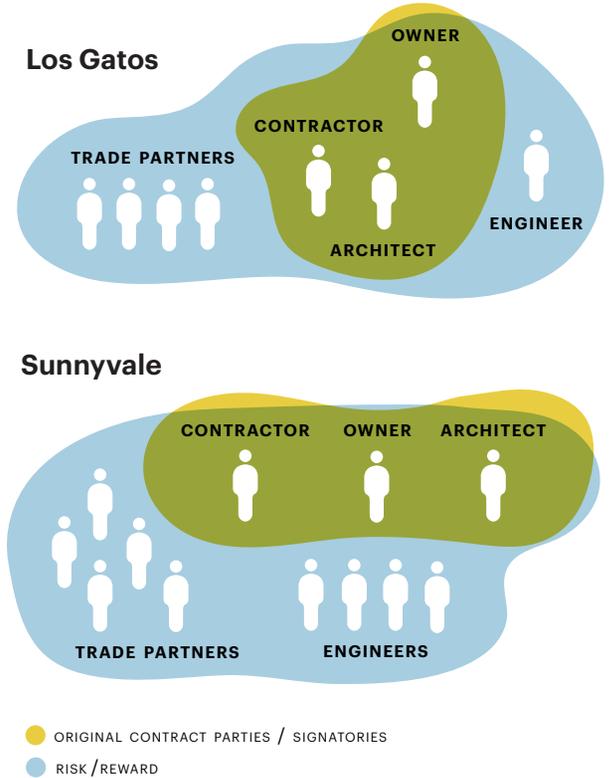
and the owner's implementation of IPD differed significantly between Sunnyvale and Los Gatos.

PREVIOUS RELATIONSHIPS

The Los Gatos project was the general contractor's first experience working with the electrical, MP, and drywall trade partners. The project manager had worked with PAMF but not Sutter. The general contractor on Sunnyvale, DPR Construction, had experience with Sutter. DPR maintains continuity with Sutter/PAMF: "We have tried to keep a core team of people in the office who are familiar with Sutter and Palo Alto Medical Foundation, and how they work. Also, [we've maintained] an integrated approach and know the people on these other teams—if one person flows off the team, it's still the same company. We still have some continuity going through as we go on these projects, and we try to keep that knowledge." The architect for both Los Gatos and Sunnyvale, HPS, had also been on the project team for El Camino, and the firm has had a similar approach as DPR about continuity, with their project managers employing comparable philosophies and goals on each project.

SUTTER HEALTH PROJECT TEAMS

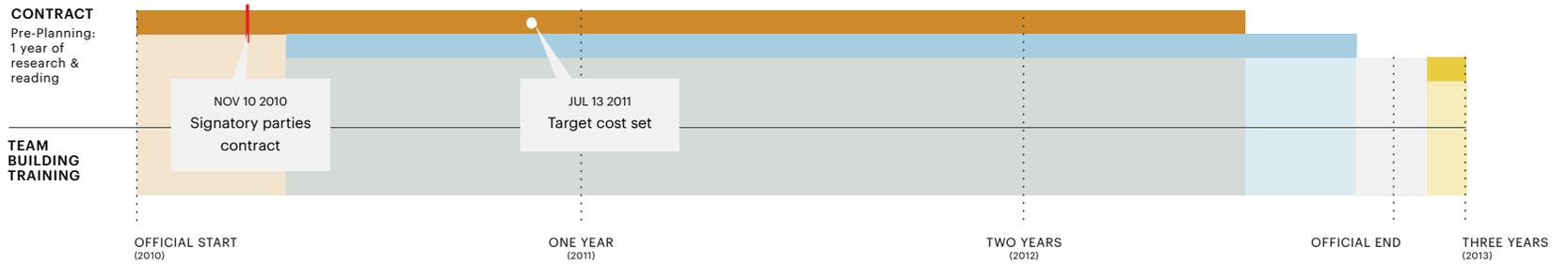
The most important shared relationship for the Sunnyvale and Los Gatos project teams was with Sutter's project manager on both projects. He intentionally used the positive relationships he had with several of the companies and individuals on both projects to model collaborative behavior for new team members. He supervised contracts, processes/controls, and the budget. Sutter also had a user representative who provided guidance to the team regarding clinic use, finishes, and furniture. The Sunnyvale signatory pool included the owner (PAMF), the architect (HPS), and contractor (DPR). The incentive pool included four engineering consultants and five trade partners. The Los Gatos signatory pool included the owner (PAMF), the architect (HPS), and contractor (W. L. Butler). The incentive pool included four trade partners.



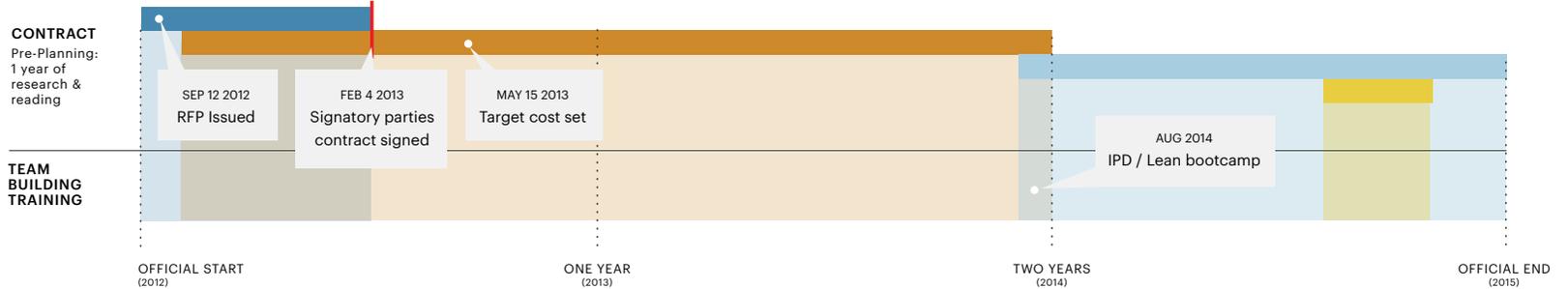
Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Project Timeline

Sutter Sunnyvale



Sutter Los Gatos



SUNNYVALE PROJECT TIMELINES

Sunnyvale contractor initiated what became a major structural change that streamlined the construction sequence and saved ten weeks (estimated cost savings of \$500,000). Overall, both Los Gatos and Sunnyvale delivered on targets set during validation.



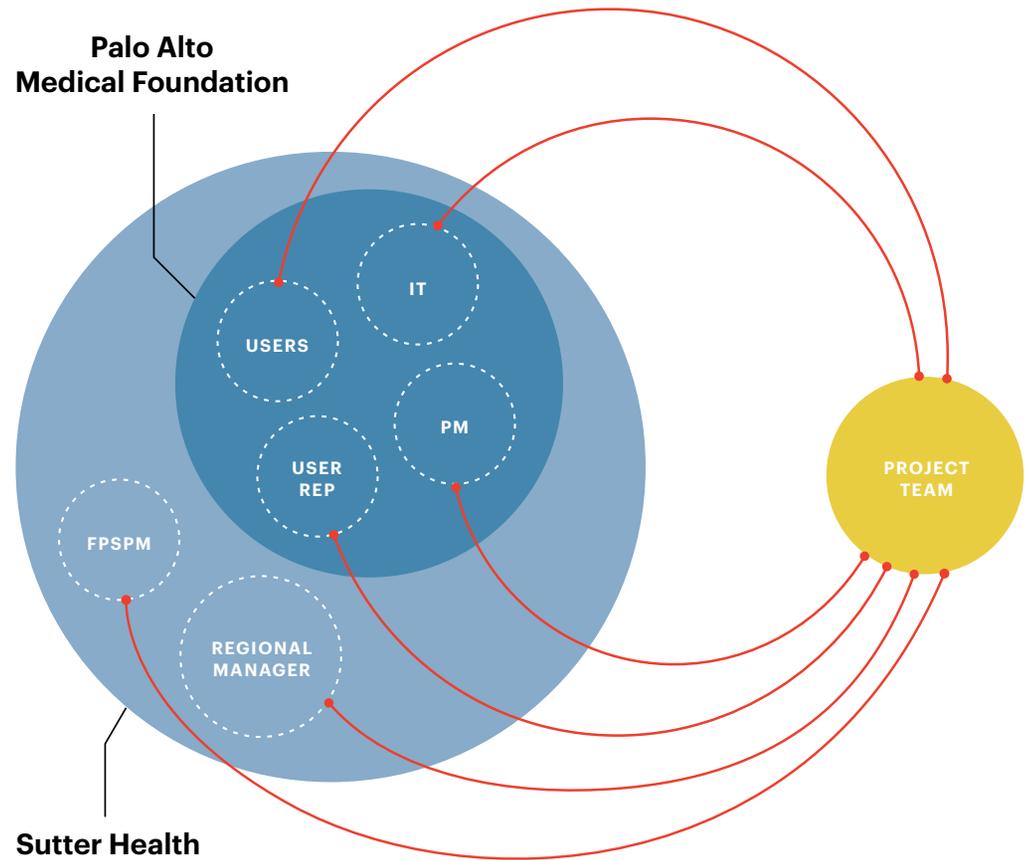
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Owner Identity & Interface

The owner organization, PAMF, has grown on average 5% a year for eighty years, with 6–7% per year increase during the past fifteen years, and the revenue growth has exceeded that. The growth is measured by the number of patients in the care group. PAMF is an affiliate of Sutter Health and can act as the building owner, requesting funds from Sutter Health. For projects over \$5M, Sutter’s facilities and property services group provides support in project management. For those under \$5M, PAMF manages, using internal resources. Both projects in this report are owned by PAMF and had project management from Sutter’s facilities group and a user representative who managed all issues related to clinical use, finishes, and signage.

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KEY
FPSPM: Facilities and Property Services Project Manager
IT: Information Technology
PM: Project Manager
USER REP: User Representative

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Choosing IPD & Lean

Sutter is one of the most experienced owners in using IPD in the United States. Expertise in IPD is not evenly distributed within the organization; they estimate that it is concentrated in about 20% of the project managers, who use IPD on approximately 10% of Sutter’s projects. The IPD projects are typically the largest and most complex projects for Sutter, representing 80–90% of their capital spending. The decision-making process for Sutter and PAMF to pursue IPD or other delivery is determined by project scope (larger, more complex projects are typically IPD), and the project managers have influence on which contract type is used on their projects. The project manager for both Sunnyvale and Los Gatos is one of Sutter’s most experienced in IPD: “It’s something I’m comfortable doing; it’s something that I like. We have about fifty project managers. Probably only ten have used the IFOA. I think from a global point of view, based on what we’ve learned, for anything over a \$20M we’re going to use the IFOA.” The project manager also prefers to do IPD on large hospital projects that fall under the regulation of California’s Office of Statewide Health Planning and Development (OSHPD). “We want the whole team on board, tied together, sharing sink or swim together. We see the most value on the big OSHPD jobs—that’s where we’ve traditionally had the most risk.” The project manager has used an IFOA on a project with a budget as small as \$1.8M but also on a \$178M project, which lasted several years.

Sutter’s project manager is driven to use an IFOA because of the increasing risks as projects become more complex: “I think the biggest risks are getting a coordinated design that you can build. The bigger the project, the more systems, the more complexity, the more risk. And that’s the root cause of all the other risks—your budget risk, your schedule risk as the systems get more and more complicated. The codes are

getting stricter. What you could say is that our projects and types of projects like this are getting so much more complex that you have to distribute the expertise because nobody can know it all. How you effectively manage a team of experts is probably at the root what we’re struggling with.” The desire to integrate and coordinate is not sufficient on its own—a process to run the project is needed. The owner noted that it’s important to know “how to structure jobs because people have always said they want to be involved early. We’ve brought people in, and they’ve asked, ‘Okay, what do you want us to do?’ And we didn’t know either. We didn’t know what to tell him to do.”

In Sutter’s experience building hospitals, design-bid-build is likely to result in projects delivered late, over budget, not coordinated, with the owner not getting what they want: “Everybody will be unhappy. We’ve shown that. Even with a guaranteed maximum price [GMP], with design assist, on a big hospital we’re not getting the outcomes we want.” Compared to GMP, he believes IPD requires more input from the owner during the design and coordination process, then significantly less during construction. He notes the extensive planning work required by a hands-on owner, like Sutter, to use IPD: “The financial management of an IFOA is very intense, including audits, tracking of productivity, contingency usage, risk/rewards, profit withholding and releases, etc.” He believes the biggest advantage of IPD is that the owner’s role during the design-and-construction process can be focused on guidance and oversight since “the IFOA gets us away from arguing over what was in the drawings and what was in the original scope. Every request for information (RFI) does not turn into a contractual change order in the IFOA. In fact, very few RFI responses are contractual change orders. This is a big difference from GMP and lump sum type delivery models.” He

points out that “IPD projects that fail, fail primarily because the owner does not play their part—they are not transparent, not trusting, they don’t make durable decisions.”

One of the members of the PAMF owner group was one of the earliest supporters of IPD. He believed that collaborative delivery would raise design quality at a time when “Sutter was obsessed with being cheap in the quality of construction, mainly in the quality of its finishes.” He stated, “I was always driving toward wanting to get something that really looks good from a patient or user’s perspective.”

- Sutter Health is one of the nation’s most experienced owners in using IPD.
- Sutter’s project manager was very experienced with IPD and believed that it is very effective for small and large health care projects.
- The narrative in this report covers two Sutter Health projects completed around the same time, Los Gatos and Sunnyvale.

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Team Selection

The team selection was heavily reliant on previous relationships and familiarity with Sutter's processes. Invitations were issued in lieu of a request for proposal (RFP) or a request for qualification (RFQ). Programs for Sutter's facilities are based on proprietary ratios and grossing factors, mostly based on the care-provider ratio to staff to patients. According to Sutter's project manager, "A big reason we use the same partners is because we don't have the time to prescriptively tell the team what they need to do on every job. I need to be able to say, 'Do what you did last time, but fix this, and keep doing that.'" Sutter's El Camino project was one of the first in the country to model collaborative terms, such as shared risk/reward. El Camino's core team (contractor, architect, structural engineer, MEP subcontractor, and electrical subcontractor) remained together on Sunnyvale; some of those team members also worked on Los Gatos.

The developer of the Los Gatos building awarded the shell construction to W. L. Butler Construction. Sutter believed having a single contractor mitigated risk for the project and hired them for interior build out. Butler had no previous experience with IPD and limited experience with collaborative delivery, but they were willing to engage the IPD process. Sutter's project manager reflected that, as an owner who believed projects done with traditional delivery could end up costing more than IPD because of change orders, "I wouldn't want to do a lump sum job with them [Butler] because they're way better at it than we are. We would lose." The subcontractors with IPD experience noticed that the Butler team struggled to understand the IPD contract: "I think they knew 'Hey, our profit's in this pool and it's at risk,' but they didn't understand exactly how it worked or the expectation of how that was supposed to influence their actions." And

yet, Butler's superintendent had a very positive experience: "Working with this level of contractors—it was phenomenal. I had a way easier time on this project than I normally have."

Because of entitlement delays, DPR's originally assigned superintendent was not available when Sunnyvale reactivated. DPR took the unusual step of offering two project-superintendent candidates for the team to choose from. Both candidates were asked about their understanding of the IFOA principles. Neither had IPD experience; one had more experience with medical office buildings, but the one that was chosen had more Lean expertise. After the superintendent selection, DPR's project manager candidates were interviewed and chosen with input from the team. For both roles, the team chose the candidates with less experience but more commitment to Lean principles.

Sutter's project manager was experienced with IPD and Lean and served as a hub for many relationships on both projects. He understood that both project teams were composed of two types of companies: those with extensive experience with IPD, Lean, and Sutter, and those with no experience with IPD or Lean, and in some cases with limited experience in health care construction. Sutter's project manager was less concerned with inexperience with project or delivery type, trusting that "we could work with those things if we got the right people." The companies with deep IPD experience assigned personnel to the project teams who had worked repeatedly with Sutter, in various roles, on an average of four or five projects. These individuals became a trusted core group that the Sutter project manager used to help build team culture and generally model IPD behavior. In addition to building culture, the project manager found that the core group supported continuous improvement: "I can ask, 'How is

this project compared to the last project? What are we doing well here that we didn't do there? And what did we do there that we, for some reason, didn't carry on?' And over years you can develop a relationship where they can be honest."

Though the general contractor on Sunnyvale, DPR, had experience with IPD, DPR's superintendent for the project did not. Similarly, the project architect for Sunnyvale was new to IPD but his firm had experience. The architect felt that the contract did not change how he worked but was aware that "it was a little foreign to have this different contract. That shared risk/reward, there are a lot of benefits to that, or there can be. But there are also some risks that really have to be addressed and managed." The IFOA was also new to the Los Gatos project architect, but she felt she had "really good support" within her firm from staff who had worked on other PAMF projects.

- Team selection was heavily based on previous relationships with the owner on IPD projects.
- The owner was open to those not experienced with IPD, even in the major stakeholder roles.
- Because of a delay in project start for Sunnyvale, the personnel originally planned for the general contractor was not available. The contractor went through an internal process before the owner interviewed and selected.
- Several companies were involved with both projects, sometimes in slightly different roles.

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Developing Contract

Sunnyvale Contract Type: Customized by Sutter counsel based on Sutter Health Integrated Form of Agreement

Los Gatos Contract Type: Sutter Health revised a template IPD agreement created by the Sutter counsel

Sutter’s IFOA agreement was used in its original form on Sunnyvale and radically restructured by the time the contract for Los Gatos was signed. With idealistic goals and heavy emphasis on “soft” aspects, such as trust, respect, and extensive requirements for specific Lean practices, Sutter’s initial IFOA was seen as a model for the industry. Over time, the contract evolved, and recently, it was significantly rewritten.

The PAMF owner involved with both El Camino and Sunnyvale compares the process for developing those two contracts: “[For El Camino], I recall that tens of thousands, if not hundreds of thousands of dollars, were ‘wasted on lawyers’ trying to come up with these contractual agreements, which were brand new to the architects. The whole idea of putting everybody at risk was just painful. When they got to the Sunnyvale contract, it was the same team, but they now had experience, and it was much easier. But initially on El Camino, there was such a steep learning curve for the players that everybody was expressing concerns to me, questioning why we needed to do this.” The architect believed their experience on El Camino was more interactive than on Sunnyvale where the owner’s attorneys dictated the terms of profit and risk. By the time of the Los Gatos project, the owner’s contract had been fundamentally rewritten, removing the soft language and references to Lean processes. The architect saw the Los Gatos contract as “quite radically different.” Sutter’s project manager agreed: “Our new process is that when we put an RFP out, it says, ‘Here is the contract. Please acknowledge that

you’ll sign it without exception.’” He attributes this different approach to the efficiency required to meet the demands of the volume of their work, under the customized contracts: “We spent a lot of money on legal fees. When there was a dispute on the project, our contracts folks would have to read and study the contract in detail to find out the specific business deal of that job. After doing that five or six times, they said, ‘We are not going to do that going forward.’” Sutter now uses three base contracts, one for each delivery type: GMP, lump sum, and IFOA. After the project delivery type is chosen, the base contract language for that delivery is not customized. The IFOA base has an addendum, called Exhibit 9, in which modifications can be documented, but Sutter’s goal is to use the contracts without modifications, if possible.

Team members who experienced multiple versions of Sutter’s IFOA contract reported that their trust and working relationship with Sutter’s project manager was strong enough that the contract differences did not change their behavior. Sutter’s project manager believes the contract differences did not have much effect on the behavior of their experienced partners, because there are a limited number of people who truly understand the contract: he estimates that of the thousand people involved with a project, only ten could articulate the risk/reward structure, and those people were project executives. He believes that “you can’t contractually mandate trust. Just because we put it in there [in the first IFOA], it didn’t mean we were getting it. We were getting it because we had project managers who had vision and passion, and we had team members who had the same thing....At the end of the day with either contract, it comes down to ‘Are you capable of doing the work? Do you want to work with us? Do you believe we’re a fair client? Is this a relationship that we want to maintain?’” He acknowledged

that this trust-based discussion is far easier with partners who participated in the early version of the contract. In the current contract, “all that contract language is not for the job. It’s for the 1% chance that the job is going to go bad.” Sutter’s project manager doesn’t miss the Lean language in the new contract. While a strong proponent of Lean practices, he is skeptical of the effectiveness of specifying Lean processes in the original Sutter IFOA: “Mandating process and behavior in a contract isn’t the way to actually get the behavior.”

- Sutter recently created a new agreement that allows for less variation between contracts, a change from their time-consuming customized IPD agreements.
- The Sunnyvale project used the customized contract. Los Gatos used the template agreement. Overall, the team behavior seemed unaffected by the contract.
- The original customized contract extensively specified the use of Lean tools and processes; the new contract did not.
- Trust in the owner’s project manager may have overshadowed any project team member concerns about the template agreement.

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Developing Parties

The owner project manager articulated that a significant factor driving behaviors on an IPD project, the catalyst that resonates with people the most, is that they get paid for the work that they do. “If the wall gets torn out and you have to bring the framer back in, you pay the framer to do the work.” He is adamant that setting appropriate budget and schedule makes it possible to maintaining the ethical stance that IPD partners should not have to take a financial loss in order to advance the project goals. He believes that “in a traditional job, you don’t always get paid for the work that you do. It’s as simple as that. And in an IFOA, the subs have access to the contingency.” Having access to funds through the shared management of contingency and understanding that each participant will be paid for their time is a key “lubricant” for the smooth running of the job. By contrast, the DPR superintendent believes that being paid for time is not always the most attractive aspect of the IPD: “The biggest thing for me is IPD has to be trust-based because it’s all good until somebody is out of money, and then we work with people who are doing lump sum work. Why would they have good people continue to come out here when they’re getting paid hourly versus sending their top people to competitively bid jobs? I think there were some subs that had done a lot of work with PAMF and took a little bit of advantage of it with their field crews. I would call that out to their foreman, and you’d see a little improvement here and there. But there’s definitely some people that I feel lost that profit motive.”

On Sunnyvale there was a total of \$700,000 of owner changes. Sutter’s project manager described “two different types of owner changes”: “We have owner changes that are discretionary and owner changes that are required. Halfway through Sunnyvale the required guidelines around pharmacies and chemo drugs said that we should have had a different

size hood that needed a different size duct that had to go three stories up to the roof. In Sunnyvale I had \$200,000 of changes on a \$110M contract, which were discretionary, that I sent to the president and \$500,000 worth of stuff that I agreed with the team was not in their validation scope but, for whatever reason, was a best practice, or a code had changed, or our internal process had changed.” By accurate validation, effective use of the IFOA, and distinguishing between discretionary and required changes, Sutter’s project manager consistently found: “Almost every IFOA job I’ve done, I’ve returned the whole contingency. We’re able to find enough savings to cover the things we missed. We also are able to control our scope creep. Once the validation study’s done, if you want to add an MRI, you have to go back to the regional president.” He noted that 90% of discretionary-change inquiries coming from Sutter user groups are dropped even before they reach the president-review process because the users realize the justification will need to be fully documented and may not be approved.

In managing both cost and fee, team members had incentive to guard the project-contingency pool, which directly fed into their reward pool, contractually described as the incentive compensation layer (ICL). The architect described the process of managing the construction costs and the costs associated with fees “the construction-cost side of things, part of the target value design”: “We would make sure that if we did talk about opportunities to either speed up construction or find a less expensive material, or maybe a quality upgrade that we wanted to do, we were pretty good at tracking who the request came in from and what the cost or schedule impact would be. On the fee side of things, we would have monthly meetings during which we would actually look at everybody’s monthly billing. If there were questions from another

team member, the structural engineer or even one of the subcontractors who were part of the IFOA, we were able to talk about it right there in the room. ‘Well, why did you spend five hundred hours on this topic over here? Is that something that was really needed?’” Sutter’s project manager noticed positive evolution in the ways that the team defined and advocated for cost changes. Early in the process, he believed the team didn’t fully “own” the changes but later became very effective in advocating clearly for those that should be designated as owner change compared to those appropriate to attributing to the project-contingency pool. Since the ICL is only based on the project-contingency pool, the team needs to be very aware of the difference.

- The owner believes that the key transformative factor in IPD is that everyone is paid for the work they do.
- The contractor’s superintendent believes the profit is a key motivator.
- Validation studies are regarded as the foundation for clarity of owner changes as distinct from project contingency.
- In the experience of Sutter’s project manager, IPD projects return all of the contingency to the owner.

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SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Champions

AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION

AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE

MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE

QUAIL RUN BEHAVIORAL HEALTH HOSPITAL

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The Sutter project manager for both projects was himself a champion of IPD and Lean, but he also worked to distribute leadership responsibility among the experienced partners and to encourage collaborative behavior.

Before the meetings early in the project, he asked the experienced partners, in particular, to model candid IPD behavior during meetings: "I told the Southland [MEP engineer and contractor] foremen that they need to challenge me in meetings. That they need to say they can't do something, to show the other foremen that you can say that. Sometimes the group needs somebody they trust to be an example, to say, 'Yeah, you can tell him you can't do it.' And then I can say, 'Okay, what can you do?'" Then you make an example of the electrician, who says, 'Oh, I can do the same thing.'" Then after five or six weeks, they're all negotiating with each other, and these conversations are happening organically and I don't need to be there anymore." The Sutter project manager has used this technique on every project: "It's not scripted, but I say, 'I need you to set an example for the rest of the people. When you speak up, realize that you're setting an example of the behavior that we're trying to create.' After it happens, I will thank them." The Southland project manager recalled the invitation to model open-book behavior for the team: the Sutter project manager "would call and say, 'Hey, I'm expecting to see you leading this group. We've got to do a budget update to see where everybody is. Make sure you guys have it looking good.' My supervisor would then say, 'Hey, let's spend some more time on this.' So we'd look at the numbers a little closer and put it in a format that everybody could understand because a lot of people would just bring their cost downloads that didn't make sense to everybody else."

Modeling communication that flows more freely than the traditional siloed and hierarchical communication is difficult. Sutter's project manager sees it as a skill that can be taught: "Teaching the teams to use their partners is challenging. Teaching the architect that they have a [construction] superintendent who they can call and ask any question they want, like 'I've got these three details, I'm not sure which one to use.' Or teaching the mechanical designer or contractor that they can call the architect and say, 'You know, the detail that you're using, we can't install that efficiently.'" As an owner, he believes his role is to create the best opportunities for positive exchange: "You create your leaders. When you see a specific exchange that's healthy, you say, 'That was a great discussion,' or 'Let's do more,' or 'That was good.' Even if it dies and nothing comes out of it, you have to do that."

Sutter's project manager promotes what his former boss called respectful conflict dialogue, "trying to create a healthy tension between the members of the project. It's really important in design. We still fail because people do things just because it got in the drawings. We had this conversation a lot on this job. I asked, 'Does every detail on your set have a customer? Do you know who that customer is? Have you confirmed with them that that's what they need?'"

- Sutter's project manager was a champion of Lean and IPD, but he also coached the experienced partners to model certain behaviors that he knew would promote the open communication and trust he wanted to build within the team.
- As an owner, Sutter's project manager believes that "you create your leaders" by encouraging instances of healthy exchange and dialogue.

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Decision Structure

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Sutter's project manager attended most of the weekly work-plan meetings for both projects. A trade partner commented that the owner "wasn't trying to make the decisions. He was just trying to make sure that they were following a decent process plan."

The team was proactive in making decisions. For example, Southland's project manager described an airflow problem that was resolve by working directly with the designer. He reflects that it would not have been efficient to ask the owner to tell them how to proceed: "[If we'd] waited for them to tell us what to do, it would have taken a lot longer."

Decisions with larger impact on the project scope were documented with A3s.

The owner tried to break down the hierarchical communication structure, bringing a lot of people to the table and empowering their teams. Sutter's senior executive believed that good decisions on Sunnyvale and the earlier El Camino project were the result of early planning and collaborative meetings that supported integrated design decisions. He acknowledged that collaboration requires time investment: "I didn't get into trying to quantify the amount of money that we spent up front to use this type of thinking in the design. But my sense is that it has a dramatic payback both in avoiding changes and avoiding complexity because they've been anticipated in advance. I'm going to come back to this word transparency of information. There were a lot of meetings that all of the players attended. They were in the room at the same time, even though the issue seemed to impact just two. If there were four or five players, they were all engaged in the discussion."

- Sutter's project manager tried to break down hierarchical communication structures to bring forth knowledge held by team members.
- Sutter's executive believed the early planning with all of the stakeholder at Sunnyvale had "dramatic payback" later in the project.

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On Board & Off Board

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The contractor for Los Gatos, Butler was “highly competent” but completely inexperienced with the collaborative practices Sutter considered core to their project teams. Since Sutter had four projects that could benefit from training, the Los Gatos team was able to benefit from shared training.

If a particular partner is not working out, the Sutter project manager tracks their work to evaluate for future partnerships. For example, thinking about a problematic subcontractor, he began with a question: “How is this company really helping me here? Because we are still having a lot of coordination issues in the field that they should have been catching, and they weren’t. It was more work to put them into the risk pool and have them on the team than they were contributing. I had two or three conversations with the project manager. What he told me during the first or second conversation was that that he had been promoted, and he had eight project managers under him. I said, ‘That’s fine, but now you need to give us a project manager because you’re not servicing the job.’ I talked to him at least three times, making it pretty clear, saying, ‘If you guys can’t step it up, then we can’t use you. Not that we don’t like you, not that you don’t do good work [when you are able to focus on our project], but we just can’t afford to use you. You’re a liability.’ He never stepped it up. They may have so much work now that it doesn’t matter. He’s never called me since.”

One of Sutter’s regular partners, Redwood Electric, was on three Sutter projects, including Los Gatos and Sunnyvale. Though Sutter’s project manager felt the project manager was good, he was not meeting his commitments because of the meeting workload. They both spoke with his boss: “We said, ‘Look, your company is our go-to. We like working with you, but you’re not meeting our requirements. You can’t have one

guy run all of this work.’ They then assigned him an assistant project manager to do a lot of the busy work, and now it’s working really well. He needed the help, but he didn’t have the authority to ask for it.”

- The Los Gatos team benefited from the group training on Lean and IPD, arranged by Sutter, and the cost shared between the contractors and owner.
- The owner tracked partners’ work on active projects to evaluate if companies should be invited to participate in future projects.

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Clarity of Goals

Sutter's project manager perceived a recent shift from quantitative goals to ones that are mission focused. "Now it's about framing the question differently. Here's what we're trying to accomplish. How can you help us accomplish that? What we're trying to accomplish is not 'How cheap can you give us this set of drawings?' It's 'We need this many exam rooms. We want this feel. We want this many zones. What's the right mechanical system? What's the right...?' We have certain standards that we use; within our standards, how do you help us achieve our goals?" He referenced the book Moneyball, saying that the Oakland A's general manager Billy Beane "figured out which factors had the highest correlation with success, and they just happened to be the factors that no one else was paying attention to." He drew the analogy to the building industry: "We haven't found the right correlations. We were first focusing on cost per square foot. There's no data that says that's correlated with better outcomes. So what is?" He discussed the connection between metrics and self-awareness: "Productivity is super important to track, not from the point of view of knowing what your productivity is but forcing people to think about it and report on it. I think we get more value by making the project manager of each company present to the other project managers how they're doing rather than from their individual numbers."

The Sunnyvale superintendent saw the schedule as the "obvious" goal on the project, "and the beauty of that was that improving the schedule was beneficial for everybody." He also noted that a major goal was ensuring that the construction process was not disruptive to the neighborhood. The entitlement process had been difficult, and the owner agreed to several terms that would have to be accommodated. The Los Gatos contractor saw the Sutter's goals as "pretty simple" and that they knew what they

wanted: "With this owner, we knew what the expectations were. We could measure what it was that we had to do in order to achieve that, and the constant weekly feedback made it pretty easy for us to do that."

Southland's project manager remembers that the owner's goals for Sunnyvale were originally communicated in a sixty-ninety-minute meeting. "The owner's goals, the big picture. The way I understood it was they got funded for a certain amount of money. We gave them an EMP [estimated maximum price] as a design and construction team, and they expected the job to get built on schedule at that dollar amount or less. That was the expectation." For Los Gatos, it was similar. "It was pretty clear. 'Hey, here's the budget. Here's the date we plan on opening. Here's the date we need to turn it over so we can start staff and stock.'"

The architect also saw that the owner's goals, guided by the Sutter project manager, were being on time and on budget. They also worked with other owner members, who are heads of PAMF, with different goals. "They wanted to make sure that the patient experience was really positive, and that's where a lot of the changes that happened during construction came about, just to meet that patient experience. We pride ourselves on our design efforts, but that's also important to us." The architect took the approach of putting themselves in the shoes of the patient all the way through the visit experience. "It's certainly very subjective, that experience, and when we would present something to a Dr. Vilaro [PAMF], we would take those graphics and talk about the feelings, about what the members might be experiencing." The architect also met several times with various user groups, including staff and facilities, through opportunities set up by

PAMF, and incorporated their feedback throughout design development.

Communication of the design goals and the program goals of the cancer-treatment center in Sunnyvale was cited as a positive motivating factor for all subcontractors, regardless of their inclusion in the IFOA pool.

For the owner project manager, "The real risk is not having an aligned scope, and budget, and schedule, because contractors are pretty good at building things and designers are pretty good at designing things. If you put them together and make them work together, they can design a coordinated thing that can be built. But if you inherently start with the wrong budget, or the wrong schedule, or the wrong scope, it doesn't matter how good you are, you can't fix that."

- Sutter's project manager perceived a shift from quantitative goals to mission-focused goals, such as numbers of patient rooms with a certain level of design quality.
- Sutter's project manager observed that the real risk on projects was not having an aligned scope, budget, and schedule, since if any of those were not correctly set, no team could succeed.
- The primary focus was on a reliable schedule and budget, as well as high-quality patient experience.
- The Los Gatos project was a tenant improvement in a new building, and the team had to balance goals of Sutter Health with those of the building developer.

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Resources & Facilitation

The Sunnyvale and Los Gatos teams each had a mix of highly experienced and inexperienced team members. There was extensive internal team mentoring, with numerous examples of coaching, reminders, and modeling of behavior. Some occurred organically, such as reminders from an experienced subcontractor to the contractor; some were planned.

On Sunnyvale, the team benefited from the deep Lean expertise of DPR's superintendent, complemented by the Lean experience of Sutter's project manager. The timing of specific Lean exercises helped the team face challenges expediently—for example, the use of the model exercise timed to when there was some resistance from a subcontractor. DPR's superintendent used an informal process to identify what issues were affecting the team and then matched Lean exercises to need. Training was weekly at the beginning, which benefited the new project team members coming in without knowledge of the project history. Later in the project, exercises tapered off in frequency. Internal Lean resources from DPR were also used by the team, especially early in the project timeline.

Overall, Sutter's project manager believed both teams gained from using Lean, but he was frustrated by the disinterest in self-reflection. For example, the Sunnyvale team participated in an international research study on Lean but didn't follow through with the feedback they received: "We got the results, and we sat down and had one meeting. But I couldn't really get the team to implement countermeasures because some of them responded, 'Well, we don't feel that way' or 'We don't care if they feel that way.'"

When Los Gatos was starting, it was one of four projects with contractors new to Sutter. Sutter decided to hire one consultant to support all four project teams with basic Lean

boot-camp training. Sutter provided half of the funds but asked the contractors to pay \$12,000 each for the training. Funds were not to be taken out of job costs and indicated their commitment to the training for their entire team. Team members generally found the training to be engaging and enjoyed having other project teams involved.

Several team members commented that the intensive early involvement by Sutter's project manager to champion Lean practices was key: "If he hadn't gone to those meetings and made it clear that his expectation was that they were going to do Last Planner System and that they were going to plan the work out, the superintendent would have just said, 'Okay, go put your stuff in.' The meeting would have been a quick little meeting, and he would have just said, 'Okay, I'm going to be here, you're going to be here. See ya.' That would have been it. There wouldn't have been...discussions." Others noted the flexibility demonstrated by Sutter's project manager: If a certain tool was meeting resistance from a team, alternative systems were considered. For example, Sutter's project manager insisted on using plan percent complete (PPC) metrics on both projects and received a great deal of pushback on Sunnyvale from DPR, who was unfamiliar with the practice and saw little value in the reporting. Sutter's project manager pushed to get PPC reported: "[DPR] told me they couldn't do it, and then I found out a year later that ourPlan [DPR's proprietary tracking system] forces you to track variances. You can't not report variances in ourPlan—it's just the way it was built. That's one example I didn't totally agree with. But there's also a lot to IPD about good enough. It was good enough what they were doing. I was pushing, but it wasn't a firing offense. It was working—I just don't agree with the way they were doing it."

During construction, the owner's project manager would informally ask team members in the field for both projects if this job was any different than any other job you've been on: "They all said no. I respect that team a lot; I think they're rock stars—yet there were things that frustrated me. We did a survey, a Lean survey [integration whitepaper survey], but [the team] didn't really like the results, so they didn't want to publish it." On the other hand, DPR saw positive results from the earliest Lean training for the Sunnyvale team. Participants in the training games were paid for their time, and it built camaraderie around shared purpose: "Right away, they knew that they were getting paid for it, and that benefited the project overall."

- Both projects had a mix of experienced and inexperienced team members, and internal mentoring was common.
- The Los Gatos's team was one of four teams that benefited from a group Lean and IPD training set up by Sutter.
- Sutter's project manager was frustrated by the disinterest in self-reflection that he found within both teams.
- On the Sunnyvale team, the contractor noted a very positive attitude about Lean training since participation was during paid time.

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Tools & Processes

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The Los Gatos project was the general contractor's first experience with Lean, though they had employed some practices previously, such as the daily huddle and something similar to the risk register. On the Los Gatos project, the general contractor worked with the project managers of the different trades to see if work could be planned more efficiently. He offered some examples of other trades being shifted ahead of the planned schedule when a company didn't have material ready. He went on to say, "Lean construction would probably be something that would be really difficult for me to explain to subcontractors in terms of why it is that they need to work a certain manner. We're trying to utilize the right amount of resources, not necessarily put a large crew on a certain project." The contractor did employ Last Planner to meet one of the owner requirements, and he said, "We didn't get too much pushback from the subs. Once they understood why it was that we were doing what we were doing, they followed suit."

Tools other than traditional Lean tools were effective on Sunnyvale, particularly the adaptation of conference-room-scheduling software to coordinate the unloading of materials on-site. During the entitlement process, the owner agreed to several specific conditions that would minimize the impact of construction on the residential neighbors. Clear parameters for the time of day for vehicle activity and limits to idling time were set, and these were communicated to the project workers and suppliers. Project team members generally respected these rules; however, the drivers for the suppliers were frequently in violation, resulting in severe and escalating complaints from the neighbors. To solve this problem, DPR's project manager developed an ingenious coordination tool for the suppliers that also served as a highly engaging incentive-driven game for the subcontractors, who were

ultimately responsible for their deliveries. DPR used in-house scripting expertise to adapt a commercially available online conference-room-scheduling system, accessible to suppliers, who would sign up for a delivery window and get a map and site requirements before they arrived on-site. The driver had a sheet with a QR code, which was scanned to confirm the assigned delivery window. If the driver was on time and had a narrow delivery window, they were unloaded immediately. If a driver missed their window or signed up for a wide time window, they would wait to be unloaded. The suppliers quickly realized the benefit of relying on the system and found they doubled their efficiency on deliveries since a quick drop off meant that additional deliveries could be accommodated. The system would also track the foreman responsible for the delivery, and for every successful delivery, they would get a raffle ticket. Importantly, if any of their deliveries missed a window or failed to use the system, they lost all their raffle tickets for the week. DPR got permission from the owner to take funds from the contingency to create the raffle pool of \$5 per successful delivery, about \$300 per week. The success of the tool was well known among the team, and many noted that IPD-shared funding afforded the unusual and unforeseen expense of the raffle pool. While not a lot of money, it would have been difficult to fund in a traditional project. The contractor received a national award for the tool and has continued to use it on other projects.

A DPR proprietary tool called ourPlan (now incorporated into a commercial software package) was also effective in tracking construction tasks but cumbersome for interactive collaborative work. Visual information produced by ourPlan was helpful, but Southland's project manager noted the benefit of having one DPR person responsible for entering information into ourPlan: "There were boards on the wall;

people were writing stuff down. This guy was inputting stuff into ourPlan to track, to say, 'Hey, did we not get this done? Can we get it done? Are we moving this from here to there?'"

In addition to the visual output of the tracking software, the two main wings of the Sunnyvale building were physically color coded, with colored paint on the concrete columns, with the school colors of the rival universities. In the Los Gatos project, the Butler superintendent found great value in his first use of location-based scheduling: "One of the things that we learned was to take the floor plan and break that down into smaller compartments, and then to manage those smaller compartments as opposed to just giving the crews rein to the entire floor. That way, you can manage the flow of the construction, and you can minimize trade stacking within a certain area because it makes the work flow that much easier. It's less cluttered; there's less chances of somebody getting hurt." Although there is specialized software to manage this, Butler adapted their own management software, along with PlanGrid and Bluebeam, to zone each floor plan and track the direction of the crews.

- Sunnyvale's contractor adapted a conference-room-scheduling program for suppliers to schedule their deliveries. The use of the program greatly reduced neighbor complaints of idling trucks and became a major win for team culture among the trade partners.
- Visual coordination by contrasting paint on columns and location-based management were effectively used.

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Lean Effectiveness

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The PAMF owner felt that Lean, 3-D modeling, and engagement of the subs in planning the building combined to create a true sense of a collaborative team: "I just like that idea of team and engagement. I like the transparency part of everyone knowing and expecting everyone else to be around the table together." The owner appreciated seeing information up on the walls.

Sutter's project manager commented that Last Planner has been so ingrained in the effective past IPD partnerships that its use is expected, regardless of any formal agreement. "If I haven't driven a team to deliver Last Planner, Southland will call me and say, 'This is not what we signed up for. We came on board expecting that there would be coordination. That's what we budgeted time for, and that is not happening.' My job to maintain trust is to step in and do something about it. As soon as I stop doing that, there's no trust and the whole thing falls apart."

On the Sunnyvale project, the team used a simple tracking log in Excel to record when anyone had something that could have a potential cost impact and how it tracked with the contingency. The tracking log was managed by the architect, accessible to all the trade partners, and the team talked about it once a week. As the MP subcontractor described, "A lot of the things ended up being nothing, but some of them were a couple hundred grand or so at the end of the day." Plus/Deltas were used, and the DPR project manager found that the discussion was usually sufficient to resolve the issue without formal follow-up action: "I think it was probably just more of an airing out. These Plus/Deltas are the kinds of things that we don't think are going well, and as a group we found ways to pick each other up when a teammate was falling down."

DPR's superintendent saw that the risk/reward pool created more incentive for participating in the implementation of Lean work, but not in every case. He noted the willingness to participate in Lean was "pretty noticeable for some of the trades in the reward pool." For others also in the IFOA, it was "business as normal." On the Sunnyvale project, the contractor speculated that those that kept to the status quo could be keeping to their union practices, and those willing to engage in new Lean practices were from trades more open to seeing its benefit. Sutter's project manager pointed out that if a company persists in doing business as usual, they are unlikely to be invited to another project.

The project architects on Sunnyvale and Los Gatos characterized themselves as having a medium level of knowledge in Lean. The MP company that served as subcontractors and consultants also felt they had medium Lean expertise. Many project team members on Los Gatos were new to IPD and Lean. All of the project participants were asked to engage in Lean practices, regardless of their level of participation in the IFOA. The pull planning process required everyone to understand much more about each other's schedule and scope than in a non-Lean project. The general contractor's superintendent noted how he had to ask for far more in-depth information than he typically did and how other participants initially resisted the investment required for Lean processes: "Foremen were asking why they had to spend forty-five minutes of their day in this foremen meeting, when they could be working. We got a lot of opposition from team members, [typically from] the older foremen that we had on job sites that had probably been in the trades for twenty years or so. To get them to buy into the system was a little difficult, but once they started seeing that by sitting in a meeting with all of the foremen, rather than the superintendent

having individual conversations with each foremen, gave everybody the know-how about where we were exactly at that moment and what was coming up. Anyone could say, 'Hey, you know what? You're saying you're going to be in this area on Wednesday. You can't be there because I'm doing A, B, and C in there.' Then we would reorient the flow of work or slow somebody down." At first, meetings took longer since people were not prepared and their time estimates were not accurate, either "building in fluff" to ensure they met goals or overestimating what could be done. But as the team saw repeated gains of seeing days and weeks on the schedule, the value of the planning was no longer questioned.

The Los Gatos general contractor sees a difference between utilizing Lean and IPD. "This experience [with Lean] definitely has a lot of components that I would utilize on projects moving forward because it really does force communication with all team members. The Lean construction method could be used on all levels of projects. With IPD, I think that it would have to be a project that was long in duration or one where we had buy-in from the ownership from the get-go."

- The contractor for Sunnyvale noted that many, but not all, of the companies in the risk/reward pool had a notable willingness to pursue Lean.
- Last Planner System is so deeply engrained in Sutter's processes that their frequent partners expect its use and budget their time accordingly.
- On the Los Gatos team, some inexperienced team members resisted pull planning, but this quickly changed as the whole team saw "repeated gains of days and weeks."

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BIM

The owner saw that software platforms were designed around the contract structures. “The IFOA’s intent is to get rid of all that stuff, but it doesn’t propose a new system. It allows the team to establish that system.”

DPR’s project manager anticipated resistance to the use of BIM by some of the less experienced partners. He intentionally focused his first Lean training with an exercise that vividly illustrates the importance of modeling. The exercise uses 2-D and 3-D information that the team members, working together, have to match to holistically understand the 3-D object. Later, the contractor set up a silent-squares game to teach the electrician the importance of not modeling anything under two inches, and “when [the question of modeling] came up later, it was hard for him to argue.”

Models were used extensively on both projects. When clash detection was resolved, the teams used the models for prefabrication.

- The teams saw benefit from clash detection but did not use BIM extensively for other coordination.
- Sunnyvale’s contractor used Lean exercises to demonstrate the value of 3-D modeling to team members who were less experienced with BIM.

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Workplace

The Sunnyvale project used several versions of a Big Room: the first was in DPR’s office, the second was a series of six trailers linked together, and the last was a shell space formed within what would eventually become the second-floor lobby. The team found all of these settings to be effective, particularly for the detailers of several companies to coordinate around BIM.

Los Gatos had consistent weekly meetings in the architect’s office with all risk-pool partners during the validation-study phase. During construction, the Los Gatos team did not use conventional co-location, but the expansive garage space was a temporary home base for many of the trade partners, who each had their own “wing.” The center area of the garage became a meeting room where materials were posted.

- Sunnyvale had a Big Room and found it especially effective for the detailers from different trade partners to be co-located and accessing the same BIM.
- The Los Gatos partners each had their own work areas within a large garage space.

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Team Alignment

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The Sunnyvale contractor saw that some partners behaved differently under the IFOA contract but was reluctant to attribute all of the positive difference to the contract terms: "I still think it all has to be based on trust and long-term relationships." The Los Gatos contractor saw that having a collective pool of money changed the way people behaved: "I think it definitely was an incentive for everybody on the project, and everybody was working as Lean as possible to make sure that we didn't dip into the fees. That also put everybody in a different mind-set. It really did bring the team together." More experienced team members noted that Butler's inexperience created a sense of responsibility for the whole team to receive updates and to communicate in order to keep Butler on track with IPD. For example, accounting systems for GMP projects with subcontractors working on a bid basis do not accommodate line items over 100%. General contractors tend to shift costs to make as many items reach 100% as possible, but this is not consistent with open-book transparency. When Southland's reports showed some line items exceeded 100% and others less than 100%, Butler told them "No, you can't do that. You need to just max that one out and then start charging us down here." Southland's project manager responded, "I can do that, but it's not going to explain the story of what went well and what didn't go well at the end of the day." In spite of the learning curve for Butler, they saw the value in the transparency and shared management, such as when each of the subcontractors reduced their scope of work and budget, and the overall budget saw savings from increased effectiveness of composite cleaning under Butler's single point of supervision. Shared equipment, such as lifts and graders, also provided opportunities for economies.

The MP subcontractor and consultant, Southland, likes doing IFOA projects because "it gives everyone an incentive to get it done but makes it so that everybody's doing well." Southland's project manager notes that they have another job with Sutter that is not an IFOA, and it's run quite differently—under the GMP, no one is championing for "the team building the job better, faster, or cheaper." Southland's project manager understood the difference between the contractual terms for Sunnyvale and Los Gatos and believed: "The contingency pool overall might have seemed a little bit simpler in Los Gatos just because there were fewer people on it compared to Sunnyvale. But fundamentally, it worked the same way." He acknowledged that there were different levels of understanding about the contract within the team, noting for those with less understanding, "it didn't influence their behavior in a way that it would have if they did understand it. It could've been more positive."

The team members understood that since everyone is guaranteed his cost, if anyone goes over budget they don't get a profit. The owner's project manager believed this understanding to be the most important thing for the team, and the result is that scope can flow to where it belongs. "The work environment in the field between the trades is so much better when money flows back and forth. You're guaranteed your cost, and you have a shared risk or a shared reward and a fixed profit." He has noticed the ease between two IPD trade partners when a minor change of scope is quickly negotiated based on the optimal cost outcome to the project. The Sunnyvale contractor foreman said they were not as aware of the details of the contract but that "at the superintendent level and the foreman level, the field generally understood

that the better we did, better than our companies did. That doing better directly related to your own company."

The sprinkler subcontractor was not included in the IFOA, and several team members believed, in hindsight, the level coordination around their work should have justified their inclusion. DPR's project manager noted that in this case, inclusion in the risk/reward pool was not an issue of behavior but affected how fluidly the team members could work with each other. He noted the sprinkler sub was very open to engaging the team, but "they struggled a lot on the modeling, and if they were in the IFOA, it might have been easier to give them some help."

- One of the IPD-experienced trade partners for Los Gatos noted that the inexperienced general contractor had a hard time tracking the full level of fiscal transparency provided to them.
- The owner noted the ease with which team members traded scope because of the guaranteed cost and the knowledge of a shared incentive pool.
- The Sunnyvale contractor noted that for subs not in the risk/reward pool, it was harder for other team members to help when they struggled with the modeling.
- Sunnyvale's contractor believed that even if the fieldworkers were not aware of the full details of the contract, they understood that "doing better directly benefited your own company."

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Collaboration

DPR’s project manager responsible for the master schedule was the first to realize that the project was not tracking to its schedule goals. He worked with other DPR personnel to discuss potential changes that could help the schedule. They identified an alternative strategy for connecting the structural steel frame to the concrete podium, which would result in a faster and easier construction sequence. While they knew the positive impact of constructability, the structural engineer needed to determine if the connection change still meet structural requirements. In the end, the change was made, and a significant savings of ten weeks resulted, with direct and indirect cost savings of \$500,000. Sutter’s project manager attributes the positive team culture for DPR’s willingness to question the podium assumptions: “I think where we excelled is that we had [created a trusting] culture by that point that allowed him to be willing to ask the questions. ‘Why don’t we...why can’t we...do this?’ And most jobs create a culture that punishes those kinds of questions.” DPR’s project manager described the efficient pathway he used: he had a preliminary discussion directly with the structural engineer and looped in the rest of the team after the change looked worth exploring. The final change was documented using A3 processes with input from the whole team to anticipate the impact of the change. Not every impact was positive. For example, the mechanical trade partner noted that his planned work flow was disrupted by new deadlines and became less efficient. Once the time savings was confirmed, the team revised schedule milestones and also amended the contract to specify the new end date. The contract revision represented an important commitment for Sutter’s project manager: We had “to make it real. The ten weeks can’t be something that you hope for and then lose later.”

Sutter’s project manager happened to be involved with a non-IPD project using a similar structure. When he suggested to the traditional team the potential for significant savings by changing their structural strategy, they told him “it was impossible. And I said, ‘We just did it down the street. I guarantee you it’s possible.’ They said it was impossible and couldn’t be done, and that it was expensive. They just didn’t want to do it. And it didn’t follow their contract. And it was extra work. Their engineer was not in an IPD team, so they would have additional costs, all these change orders.” DPR noted the success of the podium redesign was only one of many opportunities the IPD team was able to capitalize on: “I think there are always opportunities for the design team to spend more of their fee, which is pulling away, of course, at the project profit. But it may help the contractor in the long run.” The architect commented that she noticed a higher level of awareness of and appreciation for design fees by IPD contractors. The DPR superintendent described how design fees are typically not a part of the equation when contractors think about making changes. He went on to say that that his understanding of the IFOA allowed him to make a cost-benefit analysis and conclude that spending for extra design fees might result in overall project savings. After realizing the podium change would result in significant time savings, “our next thing was concern about design costs. Because usually, contractually, if it costs more [or less within the group of] my subs, I can handle all that internally, but I can’t typically get to design fees. It’s hard to even sell \$40,000 more in design fees to save \$60,000 on the job or, in this case, to save on the schedule.”

For Los Gatos, the team consolidated the monies allotted in all of the bids for cleaning and had the general contractor oversee the cleaning and managing of dumpsters. They also

took on the responsibility for a lot of the temporary lighting that had originally been in the electrician’s scope. According to the owner’s project manager, the Los Gatos spreadsheet tools were used “to keep track of when anyone had something that was potentially a cost impact.” The experienced IPD partners on Los Gatos related times when Butler seemed to blur the two scopes of work, one with shared contingency for Sutter and one run under a traditional contract for the building developer. There were occasions during group meetings when rework was discussed, and the suggestion would come up to tap the team pool. The experienced IFOA subcontractor spoke up to say, “No, this is the core and shell’s cost, this shouldn’t come out of our IFOA team pool. This is something that you guys need to pay for.” The architect recalled speaking up on several key issues to ensure the contractor understood the difference between an owner change and one funded by the project contingency.

- Sunnysvale’s contractor leveraged the team’s fluid communication and positive team culture to work through an alternative structural strategy, resulting in savings valued at \$.5M.
- Both team offered examples of pooled labor or equipment, collaboratively managed.

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Team Culture

For the Sunnyvale team, the owner regularly hosted social events attended by a wide range of project team members. These included picnics, bring-your-kid-to-work days, and outings to Giants games. A few events had a specific agenda. For example, there was a regular foremen’s lunch to seek informal input that might not have otherwise been accessible. The day after Christmas, about three months before the project finish, DPR set up an event for all of the subcontractors’ families during which the architect presented the design goals, the owner discussed the mission of the cancer-treatment program, and everyone celebrated the work. Several team members believed all these events supported mutual respect and encouraged social interaction. The Christmas event, due to its timing, content, and targeted audience, was credited with contributing to the lower-than-typical cross-trade damage on the project.

The shared risk/reward pool was an incentive for project team members to call out inefficiencies in others. The DPR project manager recalled his frustration with team members not working hard or smartly because it was “dipping into all of our money.” The process he followed was to initially speak to the person privately, especially if it was an individual worker who might need coaching. However, for larger issues, “instances of systematic poor planning” that resulted in “always having to rework or deal with the same issues, I would call that out more publicly with all the other foremen during the foremen’s meeting because then everybody else knows that it’s eating into their money too.” He recalled that other foremen were always supportive when this happened in meetings but never took the lead on calling out the behavior of their peers from other companies.

Modeling and acknowledging positive behavior was effective. Calling out poor performance in front of peers was important too. Butler’s project manager for Los Gatos described the times when things didn’t go well in meetings and how they can be positive learning experiences: “Once somebody gets called on the carpet in front of everybody else for not completing a certain task, that puts them on record. No one wants to be the guy that’s gets pointed at the next week, and that helps everybody step up. We assured everybody that it wasn’t to point blame or to shame anybody. It’s difficult to highlight our mistakes, but that’s what this process is about. It’s to identify what went wrong, get to the root source of why it went wrong, and then try and mitigate that from happening again.”

The senior PAMF owner believed the Sunnyvale team had extraordinary relationships leading to “terrific, terrific dialogue. I could pick up the phone to the architect or call the DPR lead representative at any time and have a healthy dialogue about anything. So that was very positive. I felt very good about the team and the individuals on the team.” The Sutter project manager believes, “Trust is not an input in my opinion. Trust is an output. Trust is a result of doing what you say you’re going to do, and taking ownership, and being accountable. And if you do those things, you will gain trust.”

Sutter’s project manager used an informal metric he believes is a reliable measure of a high-functioning team. “I can tell that I’ve built the right culture when somebody makes fun of me. And when people start making fun of each other in meetings, it tells you they’re comfortable with each other and they understand the uniqueness of each person enough to poke at the quirks.”

The Sunnyvale team found occasion to respond to the incentives with humor. One incentive target was the first elevated-deck pour. The original intention was that a part of the incentive pool would be released after the first deck pour—and it was assumed the pour would take place after the foundation and ground slab were complete. Due to the time saving of redesigning the structure, schedule milestones were revised but the incentive target around the first deck pour remained. “I have a picture [that embodies] unintended consequences, [it’s an image] of an open hole with dirt everywhere and one completed elevated-deck pour. I chuckled when they did that.” The owner noted that by the time the paperwork was processed for the incentive release a few weeks later, the deck pouring sequence had caught up to the originally planned schedule and it was appropriate to release the funds.

- Sutter’s project manager wanted teams to have healthy tension with respectful conflict.
- Sunnyvale’s team held regular social events they believe contributed positively to team culture.
- Sutter’s project manager believes managing a schedule is meaningless—managing your team’s ability to plan and deliver is key.
- Sutter’s project manager considers trust an outcome rather than an input that results from team members being accountable.

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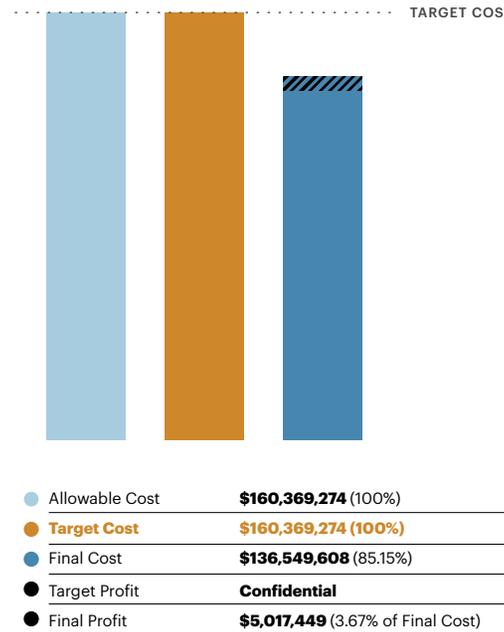
Profit & Payout

The architects noted, “We do validation studies as a part of these projects, and that’s really the basis of where the profit sharing or risk is allocated. Even after the validation study is done—maybe Los Gatos was one—the parent company has come back and said, ‘Well, we think it’s going to be this much money instead.’ Then everybody is squeezing what they already thought was a fair number, and it makes it more challenging.” Sutter’s project manager commented, “The team on Los Gatos significantly beat this ‘stretch’ budget, and the incentive payout [amount] was similar to Sunnyvale, even though the project was 90% smaller.”

Overall, the Sunnyvale project was, Sutter’s project manager said, “significantly under budget.”

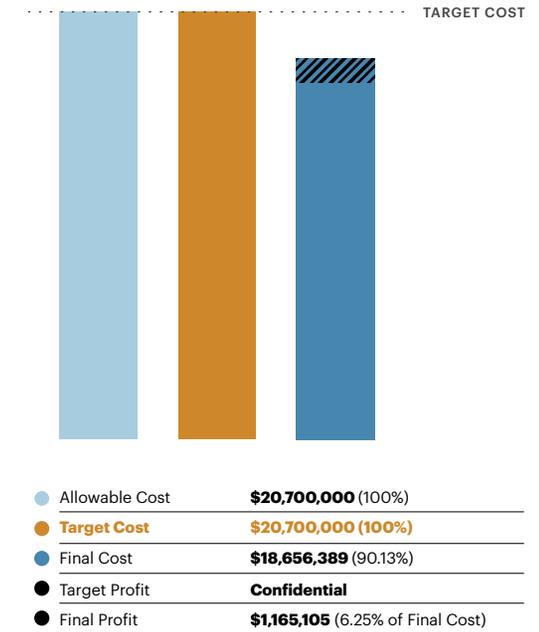
- Teams in both Sutter projects performed extremely well meeting challenging budgets.
- Reasons for success varied, but similar processes were used to validate and drive below stretch goals.

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SUNNYVALE PROJECT COSTS AND PROFIT

The final project cost of \$136.5M for Sunnyvale was approximately \$24M less than the target cost. The team received their full profit of \$5M plus a shared savings of roughly \$585K, or 0.5%, of EMP value.



LOS GATOS PROJECT COSTS AND PROFIT

The final project cost for Los Gatos of \$18.7M was approximately \$2M less than the target cost. The team’s final payout was around \$600K, or 5%, of the estimated maximum price (EMP) value.

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Budget & Schedule

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The owner's project manager believes that the metrics don't have inherent value; rather, their value lies in measuring the team's ability level. As he phrases it: "If you're managing your team's ability to plan and deliver work, you inherently get a better schedule. If you manage the schedule, it doesn't mean anything. You're managing a metric that means nothing. Looking at the schedule and the budget tells you how you were doing three months ago. Looking at the PPC that week tells you how you're doing that week."

An experienced IFOA subcontractor pointed out the potential negative effects of gaming any metric system. He gave an example of a IPD trade partner who might have incentive to shed scope in order to meet the goals for target value, even if keeping the scope would be the most appropriate and cost effective result for the project.

For the general contractor on Los Gatos, IPD schedules are based on collaborative discussion, yet "subcontractors are always going to give themselves more time than they need. There are different ways...to get to a true number. But it's like anything else. It's understanding the person that you're dealing with and what the expectation is."

The PAMF owner was focused on getting a true budget and sticking to it, but he saw the team focused on bringing in the project under budget with the potential to increase the reward pool. "There was a little conflict there as far I was concerned. There were always a host of options on the value-engineering side, and many of them I just end up saying no to. That probably can cost the builder, but it may cost the architect a little bit."

The Sunnyvale design and construction were delivered very closely to what was set in validation, and the overall savings

in IT, equipment, and contingency meant the project came in well under budget. The owner's project manager said, "A big driver of that was that we carried [within the allowable cost] a 10% contingency on top of design, construction, equipment, professional services, because we had this entitlement risk. We also had this weather risk of digging this big hole, which was going to take six or seven months before it got back up, and we didn't know what the market was going to do. At the end of the day, we didn't use a penny of that 10%, and that \$15M in contingency." Other savings came from aggressively buying imaging equipment and spending \$12M instead of the budgeted \$15M; additional savings were also realized within the IT budget.

The Sunnyvale team was behind on the schedule relatively early in the construction phase, but a collaborative change to the structural system allowed the team to save ten weeks on the schedule.

There was an issue with contingency on the Los Gatos project stemming from the way the low voltage was bought in. The electrical subcontractor took the consultant's estimate of the low voltage and put that in the EMP, even though the electrical subcontractor was already on the job and planning to do the work. "The day after we signed the EMP, Redwood gave their number and it was \$300,000 less. It showed up as the contingency doubled. They won."

On Los Gatos, there were some competing goals communicated by Sutter and the building's developer around the issue of completion and when rent could be collected, and the contractor was put in the middle of the conflict. Other team members were affected by the tension, understanding that Sutter's project manager, who was their

client, "wanted to get his stuff done to meet his schedule. The building owner wanted them to finish as soon as possible with the core and shell so he could start charging Sutter rent. [The building developer] was trying to tell us [Southland] that the core and shell stuff was going to take precedence, and so we couldn't be in [a particular] area because these guys need to get their work done first." The tension had real impact on the project when the Sutter work got ahead of the enclosure and Southland had to revise their sequence of work. Sutter's project manager believed that "on a typical contract, Southland would have issued a change order," but in this case, they shifted their work to another part of the building and worked around the problem. In the end, the delays in core and shell did not negatively affect Sutter, a circumstance that their project manager attributes to mutual investment in good relationships and trust to overcome that challenge.

- Both teams exceeded expectations around managing the budget and schedule, performing very close or below the validation study.
- Sunnyvale was behind in the schedule early in the project but saw significant savings with a structural change coordinated collaboratively.

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Building Outcomes

The owner project manager sees building outcomes as hard to measure. “How can you measure the value in this building compared to the design-bid-build building across the street that we did? To an extent, we could find a way to measure value—whether it’s through energy efficiency or maintenance callbacks, patient satisfaction, employee retentions, sick days—but we’re not measuring those things.”

PROGRAM/TENANT SATISFACTION

The PAMF owner expressed irritation with what he saw as “fundamental mistakes” in the Sunnyvale building, which was then magnified in the Los Gatos buildings, related to Lean design of work spaces for health care delivery. In both projects, he saw that the waiting rooms were far larger than necessary, and in Los Gatos, the doctor’s offices were built around the perimeter at the back of the building. “In Lean design and the way health care is evolving, it’s really about team care. Having bull pens, if you will, where the doctor, nurse, physician assistant, medical assistant all work together, is the way the Los Gatos building should have been designed. The Los Gatos building is a circa 1980s/1990s design, and I was really disappointed when I saw that because I wasn’t involved in the design of that.” He reflected, “Sutter had no understanding of Lean as an operating system when Los Gatos was designed—should have, but just didn’t. That’s not Sutter’s fault. That’s the Palo Alto Medical Foundation’s fault. That’s fundamentally my fault for not having looked at those Los Gatos plans and for not being more vocal about saying, ‘No, don’t do it that way.’”

Handling user-change requests can be tricky within Sutter’s own organization. Projects of the size of Sunnyvale generate fifty to sixty change requests: “They’re little things—we didn’t

put blinds or we put clear glass because that’s what they wanted but now they want it frosted. Patients keep wandering through the wrong doors, so there’s signage that needs to be added. What’s an owner change and what’s finishing the job? It’s a gray area we’re still trying to develop. There’s debate.” The current Sutter practice is to produce what they call a post-occupancy list at the end of a project. As the Sutter project manager describes, “We developed a list, and we told people for the first sixty days that we’re not going to make any changes unless it’s a patient-safety issue. You have to live in the space for sixty days, and then we will consider changes. After the sixty days, we developed a list of fifty items. We budgeted those items. Then we added a contingency for things that might come up within the next six months and funded that. That went up as a whole request.”

- The PAMF owner believed that at the time Los Gatos and Sunnyvale were programmed, PAMF was not experienced with Lean health care planning principles. The resulting programs have spaces that are larger than needed and don’t work well for the Lean operating that PAMF is now promoting.
- Sutter uses a version of plan-check-verify for punch-list items coming from the user groups. Sutter asks the users to live with the building for sixty days before considering and submitting changes.

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T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION

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Project Credits

PROJECT TEAM

LOS GATOS

Signatory Pool

PAMF (an Affiliate of Sutter Health), Owner

HPS, Architect

W. L. Butler Construction, Contractor

+Risk/Reward Pool

Southland Industries, Engineer and Trade Partner

TEECOM, Trade Partner

Harrison Drywall, Trade Partner

Redwood Electric Group, Trade Partner

SUNNYVALE

Signatory Pool

PAMF (an Affiliate of Sutter Health), Owner

HPS, Architect

DPR Construction, Contractor

+Risk/Reward Pool

The Engineering Enterprise, Engineer

KPFF Consulting Engineer, Engineer

TEECOM, Engineer

Capital Engineering, Engineer

Southland Industries, Trade Partner

Redwood Electric Group, Trade Partner

Schuff Steel, Trade partner

Brady Company, Trade Partner

J.W. McClenahan Company, Trade Partner

INTERVIEWEES

Owner (Sutter Health)

James Pease

Owner (PAMF)

Dr. Richard Slavin

Architect (HPS)

Craig Blackhurst, Kevin Davies (Sunnyvale), Margaret Williams (Los Gatos)

Los Gatos Contractor (W. L. Butler Construction)

Jaime Perez

Sunnyvale Contractor (DPR Construction)

Brian O'Kelly

MEP (Southland Industries)

Dominic Esparza

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Project Description

PROJECT	T. Rowe Price Owings Mills Campus Building 1
LOCATION	Owings Mills, MD
BUILDING TYPE	Office
PROJECT TYPE	Renovation
CONTRACT	Custom
OWNER	T. Rowe Price
ARCHITECT	Gensler
CONTRACTOR	Turner Construction
PROJECT START	February 2014
COMPLETION	April 2015

Project Images



Photo Credits: Halkin Mason Photography

Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 13

For the majority of the T. Rowe team, this was their first IPD project, with a few members having had experience with one or more IPD projects. More than half of the team had some prior experience, and several members had deep experience with Lean. A majority of team members had worked together on previous projects, and several firms and individuals on the team had strong relationships with the owner.

Building Size 111,000 sq. ft.



Budget \$20,241,000



Schedule 4 months design 8 months construction



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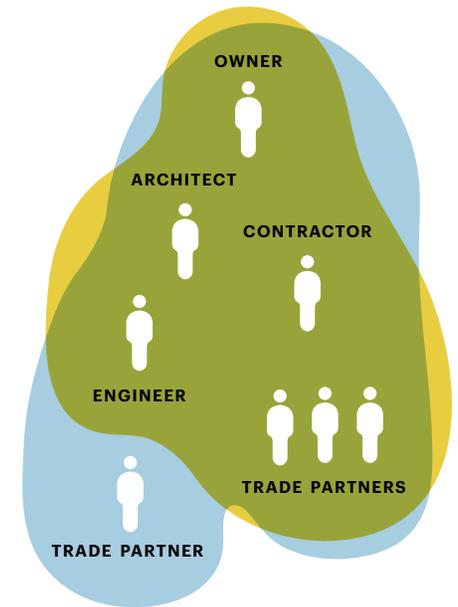
Project Description

T. Rowe Price is a global investment and financial-planning company with more than twenty offices worldwide. Experienced (and not satisfied) with tenant build outs and new construction, T. Rowe was inspired by the book *The Commercial Real Estate Revolution* to pursue integrated project delivery (IPD). The Owings Mills Campus Building 1 project is a renovation of an existing 111,000 square-foot, four-and-a-half story, seventeen-year-old office building located in Owings Mills, Maryland, owned and occupied by T. Rowe on their seventy-two-acre corporate campus. The scope of the renovation includes a new mechanical system and selective renovations of office, pantry, copy-room, conference, restroom, and lobby spaces. The owner's objective was to relocate two project teams from their downtown headquarters to the campus building, as well as maintain and integrate significant IT requirements. Other than the use of IPD, it was a fairly straightforward renovation and tenant improvement for the owner and the rest of the project team. The team rated the project as slightly less challenging than typical for most risk factors but slightly higher than typical for budget and cost factors. The project aimed to achieve LEED Silver.

The team was able to deliver significant value-add items through IPD. A key phrase the project team often used when describing their experience with IPD on the project was "Stay at the table."

PREVIOUS RELATIONSHIPS

The local Gensler team had long-term relationships with several of the project team members, including the client, contractor, and subconsultants. Turner Construction had a relatively new relationship with T. Rowe, working with them on Buildings 5 and 6 on the corporate campus. Turner's project manager was on the campus project at Owings Mills, completed shortly before the Building 1 project started. TAI had done several projects with T. Rowe, including Buildings 5 and 6. Haworth had previous experience with the owner.



- ORIGINAL CONTRACT PARTIES / SIGNATORIES
- RISK / REWARD

T. ROWE PRICE PROJECT TEAM

The original risk/reward pool was expanded to include the sheet-metal trade partner relatively early in the process. The team found that the transparency around finances, personnel, and business practices helped develop good communication. However, early concerns by one party about sharing delayed the project start. The seven signatories included the owner (T. Rowe), architect (Gensler), contractors (Turner, Poole & Kent, M.C. Dean), engineer (TAI), and trade partner (Haworth). A trade partner (Sessa Sheet Metal) was included in the risk/reward pool.

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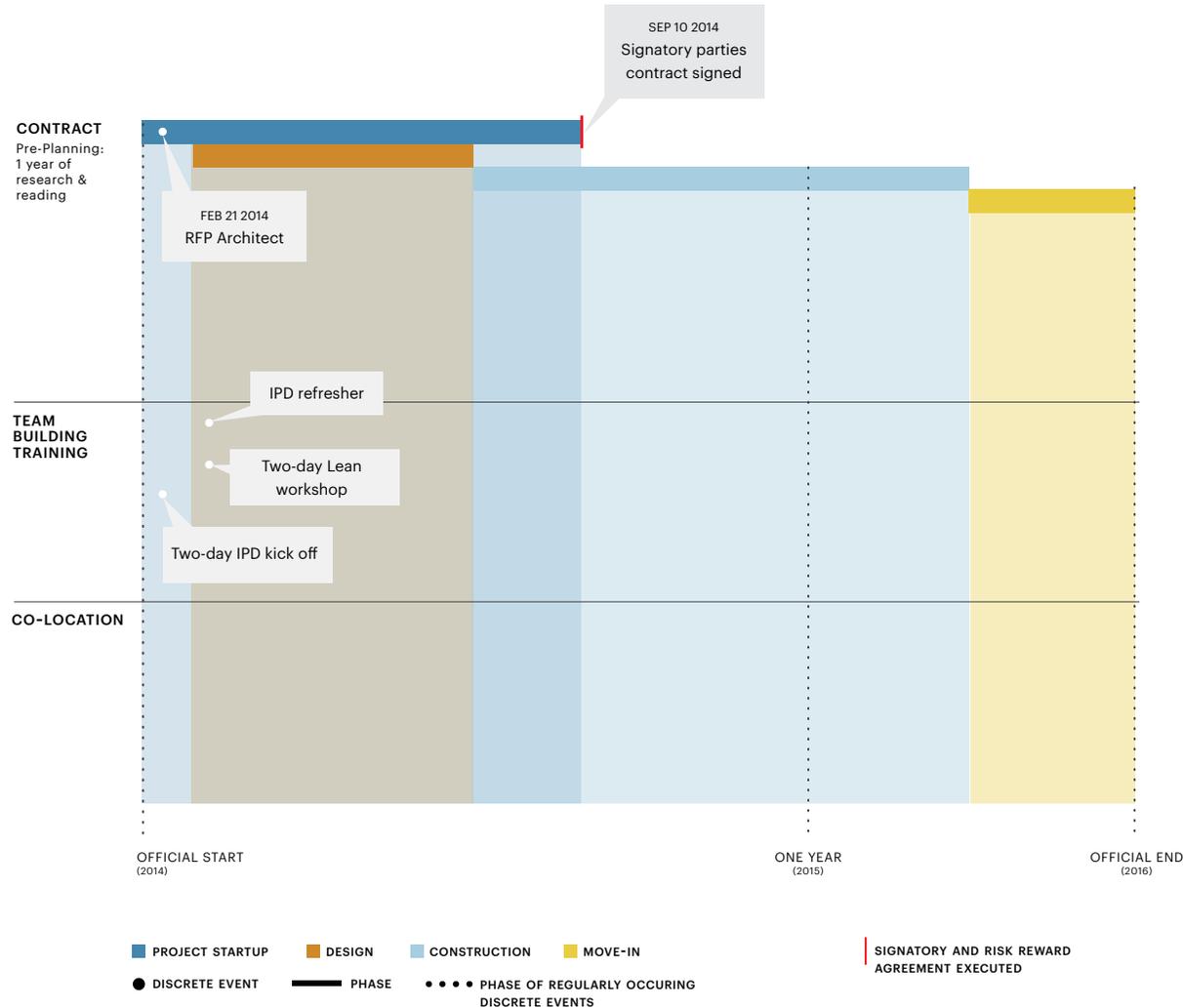
T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1

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Project Timeline

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T. ROWE PROJECT TIMELINE

The team managed several budget and schedule challenges to stay on target. They demonstrated resiliency in resolving schedule challenges while managing a process to value add scope items in a timely way.

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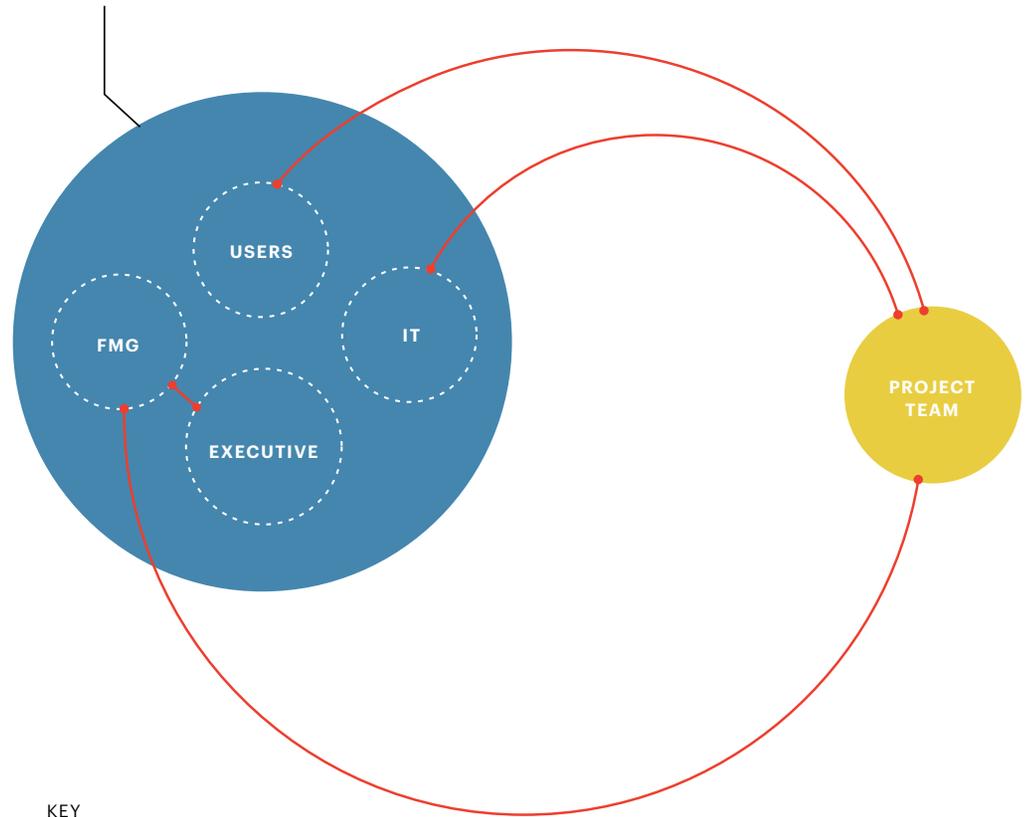
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Owner Identity & Interface

T. Rowe owns, occupies, and manages office and technical service space worldwide. The Maryland campus consists of several buildings. The real estate office serves as the point of contact, representing the owner, coordinating with a board of directors—who approve budgets and schedules—and interfacing with the user groups, ranging from tenants to their internal IT. For the most part, design and construction expectations are for conventional high-quality office spaces. Due to security and mechanical requirements for managing their financial information, a very high level of coordination was required for the electrical and mechanical systems. Two experienced members of the real estate group served on the senior management team (SMT) and project management team (PMT) in the IPD team structure.

T. Rowe's senior manager and project manager noted several differences between this project and the previous, conventionally delivered projects with which they had experience. In addition to achieving many positive aspects of IPD, there were two unanticipated differences: The multiple entities within the owner group were fairly distinct, and the distinctions posed challenges to the IPD team as they progressed. The relationships between the senior manager and project manager and the project were substantially different than in their past experiences, with less direct project involvement for the senior manager and more autonomy for the project manager. This evolution in their typical relationships was seen as a very positive outcome, but each manager noted opportunities for using their expertise as a resource by the other and by the project teams in ways that had not yet been explored.

T. Rowe Price



KEY
IT: Information Technology
FMG: Facilities Management Group

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Choosing IPD & Lean

The owner’s senior manager was the initial and primary champion for IPD on this project, referenced in this report as the Building 1 project, and the choice to pursue IPD for the owner was informed by the overlap of two key negative experiences: being forced into the role of mediator and exceeding the approved budget. For many years, his main method of creating collaborative teams was to bring the architect, engineer, and general contractor together early in the process. “We’d talk about these goals, these early goals, and everybody’s around the table and is happy and getting along well. Then, inevitably, there would be periods of time when people would be absent, or turn their backs, or point fingers, or blame somebody else.” The owner’s senior manager had multiple experiences when he felt like he had to play mediator between teams to keep people at the table, would have to fund additional work to correct problems, and would see cost overruns for which no one would take responsibility per their scope of work. “Those types of discussions are really painful to have.”

When planning for the Building 1 project, the senior manager for T. Rowe read a book that made him realize what was lacking in his previous experiences. In his words, “The aha moment for me came when I read The Commercial Real Estate Revolution and realized that the things we were experiencing in delivering projects was shared by so many others. That’s what resonated with me personally. It talked about, yes, there is a different way, and you don’t have to go through those experiences. Wow, that was the aha moment.” T. Rowe senior manager’s epiphany was well known among the team, which they referred to as the “Commercial Real Estate Revolution story.”

Though none of the individual architects involved with the project had IPD experience, Gensler, a large firm with forty-six offices, had done several versions of IPD agreements before, with some success. Yet they had less positive experiences when they felt forced into the delivery type by the owner. Gensler’s senior architect describes these situations when the owner dictates, “You want to do this project, and so you’re going to do this,” without the owner “coming through on their end of the bargain.” Because of Gensler’s close working relationship with T. Rowe, they were willing to consider IPD. Gensler’s project manager explained, “I just had to tee it up appropriately within my organization that this was a good opportunity for us to get some good experience and good traction with successfully implementing IPD projects.” According to the Gensler team, “The best thing about this is the fact that the entire team is partnering with the owner, and the owner has responsibilities to the team in this process as well.”

The project manager for Turner Construction became involved in IPD through buying in to the “concept of partnerships” and wanting to deliver construction projects without being adversarial. “I’ve always used this example that we’re not a production factory like GM or Ford, where you get forty-two opportunities to do prototypes and then take it around the test track. We’re in a business where we build a prototype and finished product all in one shot, and there needs to be a collaborative process to do that, and lump sum bidding isn’t doing that.” Though Turner at the time had few IPD projects on the East Coast, they had a significant number of IPD projects on the West Coast and as a company had an understanding of IPD. Turner’s project manager saw his company as risk/reward conscious with expertise in risk

management and that “sometimes IPD is stepping into some uncharted territory if you don’t really have confidence in your partnerships, and as this is growing as a delivery method, there’s a lot of opportunity for new partnerships.” Therefore, Turner viewed having proven friends they could count on and who they respected as key.

Poole & Kent does a lot of design assist and design-build work, which they see as falling into the IPD category, and engaging IPD for the first time was in line with their identity as a progressive organization. “When this environment came up, we thought, ‘Great, this is what we’ve always wanted to do.’ And to not only have the construction manager on board but also have the architect and the owner, to be able to have this collaborative effort and to have that input up front, it was very refreshing for us.”

- One of the owner’s goals was to avoid serving as a mediator of team conflict.
- The owner used The Commercial Real Estate Revolution as a starting point for this project.
- The owner placed high priority on reliable budget and schedule and knew that IPD had been shown to achieve both.

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Team Selection

The architect, contractor, and furniture vendor were selected based on previous relationships with the owner, and they participated in the selection of the rest of the team. Team selection was a very thorough process. Questionnaires were sent out up front, taking into account factors such as proximity, reputation in the market, and how willing the firm was to adapt business practices. After the architect and contractor had been awarded the project, a request for proposal (RFP) was issued to seek design consultants and trade contractors for a “highly integrated, jointly managed” IPD team. It articulated the owner expectation that the team “organize in a way that promotes innovation and collaboration across a wide range of project delivery activities, without being limited by traditional organizational structures or approaches.” The owner further outlined expectations that the team meet the need for expertise in the applicable facility type, building information modeling (BIM), IPD, and Lean design and construction.

For the owner, getting Gensler on board to do IPD on the project was seen as critical to it moving forward with the new delivery type. During the initial IPD contract discussions, the firm was hesitant to agree to release information on billable hours, but this was worked through and resolved, and the architect was fully on board.

T. Rowe, Gensler, and Haworth had worked together on many projects and were seen as the initial core group. Turner was another close firm having worked on some projects with the team. According to the owner, “Those firms were part of the team because they were with us all along to help us understand more about IPD and were part of the discussions of ‘Should we go forward with this?’”

These four formed the primary group that helped select the other team members. In the words of trade partner, TAI, “Then we all became a common core.” Soon after the project start, the team recognized that the sheet-metal subcontractor had a significant portion of the contract and should be added to the risk/reward pool. The team continued discussions throughout the project and eventually brought on several additional subcontractors, who had a tangible impact to the projects, into the risk/reward pool.

For the owner, the right team members generally became obvious to the interviewer during the process: “When you go through and talk about it, you quickly hear who has experience, and who doesn’t have experience, and who you think will be effective and successful, and who you don’t.” The exception was the mechanical subcontractor—two parties neck and neck—with the review team split down the middle. “We had conversations with each. And we ultimately made a selection.” The selection team ultimately made the choice around the feeling that the chosen contractor was more willing to jump into IPD, even though they were less experienced, and that there was more of a personal connection through pre-existing relationships with the overall team.

During the interview, the eventually selected Poole & Kent senior management team (SMT) member was asked if he was going to be involved in the project. He replied, “Yeah, I’m the guy. I’m here. I’m not a distant vice president of operations, just being nice. I’m here, whenever you need me, I’m here. I’m managing the job.” In terms of team selection, Haworth noted, “We all felt really good about the decisions in the end.”

EXPERIENCE

The senior manager and project manager for the owner had been involved with projects for nine years with T. Rowe and with each other. It was the senior manager’s primary project and his highest priority at that time. Turner had significant experience in IPD within the company, but their team members on this project did not have experience. According to the Turner’s project manager, “I felt like I got my arms around it, and did a lot of research, and had a lot of internal help and coaching on it. But when it came to ‘Day one, pull the trigger. What are we going to do tomorrow?’ it seemed like a vacuum, which is a total different perspective from where I am today.” Turner perceived that M.C. Dean, Poole & Kent, and Haworth also had significant IPD experience within the companies. This was TAI’s first IPD project, though they had significant experience with design-build. Poole & Kent had been involved with IPD as an organization and worked to involve the right players; they eventually brought on people within their company who knew the nuances of IPD.

- The owner’s evident commitment to full participation convinced others that the IPD experience would be positive.
- The willingness to engage was prioritized over previous experience with IPD.
- Several conventional criteria were balanced with the stated ability to work in an unconventional unconventional delivery-organizational structure.
- Several of the firms and individuals on the team had strong relationships with the owner.

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Developing Contract

Contract Type: Custom by Hanson Bridgett based on their standard IPD agreement

Several teams' counsels were present during the contract formation to read through and resolve questions holistically up front. Waiving the right to sue was discussed at the beginning of the project but was not overtly discussed afterward. After the initial cursory review, Gensler had a concern about revealing their direct cost, which they saw as indicating detailed information about how they build their business. The team worked through that by agreeing in the contract to not publish their hourly rates outside of the project team. For much of the project, the contract was "put in the drawer." When issues came up later, the team referenced the contract to make sure they understood how to interpret liability issues.

From the perspective of the owner, the terms of the contract were negotiated relatively quickly, and there was not a lot of discussion around the liability waivers. They were surprised at the large amount of discussion it took to get their insurance carrier comfortable, which was done internally within T. Rowe and did not include the full project team.

Gensler viewed the previous working relationships between team members as helpful during the contract negotiations and that they worked through the more difficult parts in a way typical to any type of project delivery. The SMT worked through the contract in dialogue with the owner. For the project management team (PMT), they knew the contract framework was there, but they were not brought in on the contract negotiations and never felt the need to focus on it or "to go in and be governed by it."

Turner's counsel had done IPD contracts previously. According to Turner's senior manager, their lawyer saw that most of the

team embraced the liability concepts within the contract and generally took the approach that "a contract is supposed to represent the spirit of the business deal." The senior manager continued, "You have to educate the people outside the project on how a flow chart looks differently on this job than another job. But in concept, the responsibility lies where it is. You can't have too much heartburn about it."

TAI viewed the contract process as quick, with only minor change, such as wording, and were comfortable with the liability waivers. Multiple firms had their attorneys at the boot camp, including TAI, Gensler, and T. Rowe, which TAI found helped streamline the process: "It was really helpful, having our counsel at the boot camp to get the big picture, so they weren't just looking at the agreement and saying, 'I don't really know the end result and the reason we're doing this, and I have all these problems with it because it's a different contract.'" TAI rarely turned to the contract during the project and felt that it didn't restrict their work.

For Poole & Kent, the contract introduced improved equality for subcontractors: "Most of the contracts that we typically see as a subcontractor are very one-sided. We get crunched down on and beat on and really have no rights." They even adjusted their non-IPD contracts with subcontractors to ensure that their superintendent would be involved with certain planning meetings early on: "They understood that even though it takes time for the superintendent, the benefit far outweighs the time commitment." They now see subcontractors seeking out opportunities to work on IPD projects because of their efficiency, resulting from being so well planned.

- Overall negotiations were relatively quick.
- There were some delays resulting from the architect's concern about how some internal business information would be shared and from the concerns of the owner's insurance carrier about liability waivers.
- Key trader partner was added to the risk/reward pool without being included as a signatory to the IPD agreement.

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Developing Parties

Transparency around finances, personnel time, and budgeting meant that the project team knew a fair amount about each other’s financial stake and business model. At the beginning of the project, one signatory firm was uncomfortable sharing information they considered would reveal proprietary business practices. Negotiations to resolve this delayed the project start. Eventually, it was agreed that the information would be shared in a controlled and limited way.

After joining the signatory pool, Poole & Kent, the MEP trade partner, recommended that Sessa Sheet Metal, a local subcontractor, be added to the risk/reward pool due to their large impact on the MEP contract. They worked with the lawyer who authored the original agreement to get the subcontractor added to the incentive compensation layer (ICL) after the project began, with the result that Sessa was the only participant in the risk/reward pool that was not a full-signatory member in the IPD agreement. The Poole & Kent SMT saw Sessa as changing their attitude “full circle,” from their initial resistance to fully understanding the benefits of the contract and becoming as motivated as the rest of the team. Based on their positive experience expanding the risk/reward pool on Building 1, the team, on the subsequent Building 2 project, decided to bring on another subcontractor—the furniture installer—into the pool at the beginning of the project because of their large impact on move-in schedules. For a future project, they are also considering bringing on a controls contractor, who is critical in systems integrations, operation, and providing continuity of online services. “Having those guys come in as part of the risk/reward team, incentivizing them to be part of that team, would really help. Bringing them in can add to better collaboration because they are a key part of the system and making sure it’s going to work right.”

Poole & Kent were somewhat apprehensive about IPD at first, but knowing that the overhead would be covered without potential for a loss made it possible to move forward with the project. Poole & Kent’s senior manager paraphrased other MEP contractors who declined to participate: “No, we’re not interested. We don’t have the people or the staffing to be that intuitive and be able to stick our necks out before design, say, ‘I’ll sign the line,’ and control for the variables with transparent budgets that can be tracked.” Furthermore, the Poole & Kent manager saw that the intense management required up front in the process intimidated some firms, especially since the profit payout is delayed until project completion. Poole & Kent found that IPD reinforced their own best practices. They scaled up some of their standard practices, resulting in value to the entire project team. With IPD, “all of a sudden, it was taken to that next level.”

At initial high-level planning meetings, the group talked through the big-picture schedule and addressed the need for more up-front time in their preliminary schedule. The senior manager owner spent less than he expected based on his coaching and preparation, yet he received feedback from many of the team members that they spent more hours and their time was more intense than they expected. “That was a big complaint early on—that it’s too much work, there are too many meetings. People hadn’t budgeted their time appropriately.” In the end, the owner viewed the overall time he spent as comparable to non-IPD projects, yet a much more enjoyable process. The architect also saw that a significant amount of time was invested up front, but across the entire project, the time was equal to or less than a normal project since construction administration was less intensive than typical. Instead of weekly construction meetings lasting four hours, they were thirty to sixty minutes. “It definitely got

exponentially more efficient for us in the construction phase.” Turner also prepared for more up-front time by properly allocating resources and saw savings on the back end by being able to reduce the overall schedule duration. Poole & Kent felt they did a good job managing time having done many guaranteed maximum price projects (GMPs) that way in the past with big clients who focused on details early in the project. But they also learned to be more flexible on the Building 1 project, which has made them better prepared for the Building 2 project. Poole & Kent’s project manager said, “One thing I learned was that I can always throw a number out, but I better have the backup. Once the team realized that, then we developed trust because my estimates were clenched with backups. Only one out of ten times did I actually have to go into details about the backup, and usually it was because they wanted to understand it technically, not financially.”

- One of the firms was uncomfortable with the degree of transparency around business practices; negotiations to resolve this delayed the project.
- The mechanical trade partner recommended that the sheet-metal fabricator be added to the signatory pool; the fabricator was somewhat resistant so they were only added to the risk/reward pool.
- The team members had to adjust the amount of time they needed to participate in the open-book process since documentation was more extensive.

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Champions

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The owner's senior manager was the initial champion for IPD, organizing a meeting with the authors of The Commercial Real Estate Revolution and the eventual SMT representatives from Gensler and Turner. Turner's project manager recalled that the book was the starting point "and from that, we headed down the journey."

Turner was seen by the architect as "adept and successful in leading and framing the process for everyone moving forward, and the PMT representative for Turner definitely pulled the lion's share. He is a good example of a really consummate professional in terms of what he does and what he does for his clients, so I think when you have a person with a strong skill set in terms of leadership and running projects and doing things like that, once you put them into this framework, it just allows them to be even more successful."

During the project, Turner's project manager took the lead in coaching the foremen in IPD and Lean. Poole & Kent appreciated that Turner covered IPD and other issues around safety and keeping the site clean, "so that in this case, I don't need to do it."

Based on the success of Building 1, TAI has been discussing the IPD process with other owners who they think would benefit, such as those doing renovations with a high probability of unforeseen conditions and owners doing repeat work. Gensler believed they met their aspirational goal to improve the workplace design of Building 1 and brought value to the owner in terms of using the design process to achieve their own evolving goals. Gensler intends to continue pursuing IPD projects and has been making presentations on their Building 1 work. Gensler's senior architect commented that the project "gave us the opportunity to be known in this local market as

a team that has experience and depth and success with this, and hopefully we'll be able to leverage this into successful opportunities with other clients and other teams."

- The owner's senior manager was the initial champion for IPD, inspired by The Commercial Real Estate Revolution.
- The general contractor became a leader in moving forward the IPD and Lean processes.

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Decision Structure

Within T. Rowe, after projects are approved, the senior manager and project manager have a relatively high degree of autonomy. On Building 1, the owner's senior manager and project manager convened an internal T. Rowe steering committee—heads of business, HR, and general management—to whom they gave monthly progress reports. The committee was asked for guidance on major decisions, but they were not involved in running the project. The other owner groups involved were IT and the associates. Associates in each program area named a high-level person responsible for their budget, who could contribute money to the project if they wanted something the SMT did not agree to fund. Because of the high level of involvement of the IT team in the project, the IPD consultants suggested that they be included as often as possible. The IT group initially resisted investing time early in the process, but after the first day of the boot camp, the owner's senior manager shared with the team an email he received from an IT team member stating, "This is where we need to go [to have an integrated process]."

The representatives to the project implementation teams (PITs) were identified during the IPD boot camp. Rather than having the PITs be a microcosm of the whole team, key members of each trade, with specific responsibilities for expected tasks, were grouped into the same PIT. Specialty owner areas, such as IT, placed key people in different PITs in order to facilitate crossover. The owner discussed the change in meeting tenor from report outs under a traditional delivery method to working meetings under IPD: "You're bringing people together to actually do work, and work on the fly. And you're going to document less."

The decrease in documentation led to disagreement within the owner's group, between the management and the IT

group. The IT group felt there was not enough accountability in the highly verbal process. The owner's senior manager said, "There's a lot of trust involved in people following through on what was agreed. They [IT] need to see it; they need to touch it. So that was an adjustment." According to Poole & Kent, it took a while to figure out the personalities of certain IT members on the owner's side, who were "looking after quality, setting the bar," and adjust their work to meet those standards.

The SMT/PMT/PIT structure outlined in the contract functioned well overall. The team believed the relationship between the SMT and PMT could have been more effective and are making revisions to their processes in future projects. Several team members commented on the large investment of time. The schedule followed a regular rhythm: the SMT had biweekly conference calls to touch base; the PMT established the PITs and set their schedules early on. During construction, the team had daily huddles in the field as a part of Last Planner System. A trade partner commented, "A lot of meetings to produce four floors versus a few meetings to produce a million-square-foot warehouse."

The owner representatives to the SMT and PMT had worked together before on traditionally delivered projects. In this project, they noted a difference in their relationship to each other and to the project. By defining roles and working as the SMT and PMT, the owner's representative to the PMT was more autonomous and more accountable for making decisions, which kept the owner's SMT representative further away from the details of the project. Since the owner's SMT representative had been highly involved in the details on previous projects, this shift was "difficult" but in retrospect was considered a positive change. The owner's senior

manager said that in the past, "perhaps we were too heavy handed, too involved in the details, not trusting of the teams that we were bringing on board." He had a similar reflection about the way T. Rowe worked internally, and the project set in motion a change in the roles within the owner group: "When you look what we did on Building 1, we can now see why T. Rowe [as an owner] was influential in our lack of good experiences in past projects."

- Internally, owner decision-making was relatively straightforward.
- Information technology was an important subgroup within the owner entity, and their inclusion in the training was beneficial.
- Fluid decision-making can be better and faster with less documentation but can lead to tension later if documentation expectations are not clear.
- The amount of time invested in decision-making in IPD is significant.

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On Board & Off Board

The team considered the IPD boot camp to be the most effective on-boarding tool. The firms tried to have everyone from their teams involved to include them in the big picture. There was no significant team-member turnover during the project. On-boarding of new members from the T. Rowe group occurred throughout the project. The owner SMT realized that greater involvement of T. Rowe specialists would be critical to the project, but since many of the owner team members were unfamiliar with the construction process, there was a learning curve for everyone. As noted by Poole & Kent, “As people got added into the process, it was as if all of a sudden, we’re learning a whole other part of the T. Rowe business. A lot of these people were not even used to working with contractors, let alone IPD.” Poole & Kent paraphrased the owner’s approach: “We have to have our own internal meeting and do a bit of explaining about what this process is because our people don’t understand this process. We’re kind of acting like contractors, and you’re going to be much more involved.”

About one-third of the way through the project, the team worked with the PMT to make changes to the membership of the PITs in order to include more voices. They increased the number and diversity of the PIT members, and it had a dramatically positive effect: “It was like a 180. The relationships were already in good shape, but it evolved and got better. I think it was everybody getting to understand the process.”

While there was agreement on the importance of on-boarding within the team, there was variation in the understanding of what the process entailed and who should be responsible for implementing it. Several project team members mentioned the importance of bringing new members on to the team in a way they could quickly enter into the work flow: “You

have to get your people on board. This isn’t a six- or eight-month decision-making process. This is getting your facts together and making the decision within weeks.” Some of the firms were responsible for the on-boarding of their own team members and felt it was successful. There was general informal support for all new team members from the Haworth SMT member who had the most experience with IPD and had played an early role as IPD advisor. For those who missed the IPD boot camp training, she sent summaries, offered to be a resource, and reminded the rest of the team to talk to the new members, noting that “it’s a lot to throw at somebody when they’re brand new.” Overall, the project team had a few major personnel changes, which were handled well.

- The PITs were changed to diversify their membership and include more members from the owner group. This had a dramatically positive effect.
- All team members agreed on-boarding was important but differed in their approaches to it within their companies.

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Clarity of Goals

The RFP stated the owner’s key values and objectives as 1) minimize adverse impact to operations during construction, 2) provide superior value within budgetary constraints, including wise management of costs and contingencies.

The general overarching aspiration of the owner was “What’s the value to our customer, the T. Rowe employee? What’s the value of the end product?” The Building 1 renovation was to accommodate two groups relocating from the headquarters to the campus because of a change in their space requirements. From an employee perspective, the project was politically sensitive within the company. The owner went through a series of steps to understand what was critical to the groups that would occupy the building but still felt they were falling short of what the groups really wanted. This prompted the owner to see it as their “mission” to find savings to so they could add those things back into the job that could create a better user experience of the space.

Two recently completed buildings on the Owings Mills campus delivered with conventional methods were benchmarks for the Building 1 project, but the budget for Building 1 was lower than those precedents. The owner’s senior manager understood the challenge of managing that budget decrease in the process without necessarily reducing the design quality. Because the budget was lower, they knew that Building 1 would not be able to duplicate the design quality of their most recently completed buildings, but they wanted it to be “referential,” alluding to them. Based on the way the current sixteen-year-old building had aged, the owner intended the renovation to extend the lifetime of the building by another sixteen years. As owner and occupant, T. Rowe looked at the estimated useful life of all the building components

and allocated money for the life-cycle cost of operating and maintaining the buildings.

At the outset of the project, the owner’s goals were clearly communicated to the project team. The big-picture goals were relatively normative: cost certainty, schedule, creating a valuable space for the occupants, and working collaboratively as a team. One team member speculated that responsible use of funds on this project was important, to model the business case of T. Rowe as a financial institution; however, this goal was never explicitly stated by the owner and was not widely known.

At the kickoff meeting, the owner focused on communicating aspirational goals, such as achieving LEED Platinum, rather than metrics-based goals. TAI viewed the IPD boot-camp training as where the owner and team goals and values were identified and communicated. The owner did not do formal follow-up check-ins, a shortcoming noted by the owner as a lessons learned and which is now in place for Building 2.

There was very consistent open and effective communication on the project team, as well as a team culture that allowed participants to believe that collaboration would support the project goals. Strategic and respectful relationships between companies were built, but not through formal agreements. It was clear that the team outcomes and building outcome were positive. The majority of T. Rowe’s team believed they completely met the owner’s goals for program, schedule, and cost; completely or mostly met goals for quality; and mostly met goals for innovation. Understanding that the owner placed their emphasis on program, schedule, and cost, the team found those to be the most motivating of the goals. Overall, the building outcomes were very positive.

T. Rowe’s senior manager said, “My goals for Building 1 were just to have a successful IPD project, not much more than that. But with Building 2, it’s more like, ‘Let’s really try to step this up a little bit.’” Turner’s project manager remarked, “I think we’re much more aware now of the importance of continually checking yourself and checking the project against the goals.”

- The team understood the project goals were primarily for reliable cost and schedule. Maintaining functionality, particularly for IT, over the course of construction was also key.
- Recently completed renovations provided a benchmark for design quality for this project, although the budget for this project was less than the benchmark per square foot.

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To choose a facilitator for the team, the owner interviewed two IPD consultants and selected the person who had the most direct experience with the base agreement. The IPD consultant assisted in interviewing the team members and developing the RFP and the two-day project kickoff, during which he set the stage for IPD through talking about its history, its intentions, and benefits. The consultant then helped negotiate the contract, which the owner saw as “really effective and really helpful for us” because he spoke in layman’s terms and not as a lawyer. The team brought him back again before setting final target costs to make sure they were in the right mind-set. At that time, the SMT sensed that target value design needed a stronger process for feedback. As the owner described, “It seemed like we were operating as normal [non-IPD mind-set], that there were signs of operating as normal, so he came back and helped us do a refresher.” The SMT representative from Haworth saw that the team wasn’t leveraging the Big Room and that “a lot of the design process went quickly ahead without really any of the innovation side coming in. So my gut says, ‘This is a new team. We need a little coaching.’”

During the initial boot camp, the team characterized the contract as a “positive reinforcement” that fostered working together and helped to avoid finger-pointing-type situations.

In addition to the IPD workshops, the team did a two-day Lean training early on through Turner, with their internal Lean project consultant. The training involved all of the team members, including the SMT, PMT, foremen, and superintendents. Turner viewed the training as very valuable, especially since the team included those with deep Lean experience as well as those with little experience.

After the close of the Building 1 project, the team turned their attention to Building 2 and decided to bring in a new IPD consultant, who they felt could really “help the team on the ground,” for a full day of training. For the owner, they brought in the consultant to continue to try and fully explore the potential benefits of IPD: “He came in to help us understand, okay, you got the [IPD] structure right [on Building 1], you got the envelope right, but how do you really, then, work together? How do you really ascribe to the principles of IPD? How does everybody fully trust each other? And how do you really take advantage of maximizing the ability to save time through sharing work?”

- The initial workshop training in Lean and IPD were effective, but the team felt the need for additional support later in the project.

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Tools & Processes

The team employed a host of Lean tools and processes effectively. Through the application of Lean, several metrics emerged as important for the team; one of the most frequently referenced was plan percent complete (PPC), the percentage of promises kept compared to the number of promises made. Turner was responsible for tracking all the metrics. Turner’s project manager recalls that for PPC, “Gensler was one of the top [performers], which really surprised a majority of us because usually it’s the architectural firms that are lagging.” In general, all the team members believed their work on this project exceeded their typical performance. One firm’s team was 86% reliable on this project compared to 50% for comparable projects. For Turner, “It seems like a lot of times people come up with half answers or excuses, but with PPC, you got 0% if you didn’t have the complete answers, so it put the onus on the party to get whatever information they needed to meet their commitment.”

The SMT used dashboards and Plus/Deltas, which were used when the team got together for learning. Turner managed the SMT dashboard, which was a variation of A3 format, called executive summaries. The PMT used a lot of dashboards. PPC in the constraint log measured team performance. TAI used Choosing by Advantages (CBA) to determine which mechanical system was optimal for this project.

The pull planning sessions for Building 1 were more focused around the construction-phase activities than they were around the design-phase activities. For Building 2, the team did a pull planning session at the outset of the project to establish milestones and to let the design teams feed into it.

On Building 2, the team took Last Planner down to the level of the foremen. The MEP contractor observed, “We drilled down even further with the foremen. We did a big picture [look].”

- The team significantly increased accountability using plan percent complete; the architect was the top performer.
- The SMT used a dashboard that was a variation of A3.
- Pull planning was focused on the construction phase; the team believed that there would have been more benefit to including more design information and including more of the early phase.

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Lean Effectiveness

Related to target value design, cluster groups, set-based design, and CBA, Gensler commented, “We created our own definitions of a lot of those things, and we’ve learned through the course of the project work how we could have probably better utilized those tools.”

The team developed an aggressive constraint log in lieu of meeting minutes, using PPC to prioritize action items that were tied to numbers, and got better at using it over time. Turner’s project manager said, “We became more reliable as a group. We policed ourselves. Everyone was very aware of their percent, and we were all trying to not drop the ball.” The log was used at every weekly construction meeting, and the teams found that their averages were much better than on other projects.

- The team adapted many “pure” Lean tools but also created their “own definitions” for others.
- PPC was used effectively as a constraint log in lieu of meeting minutes.

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BIM

BIM was specifically addressed during the interview period, as each team member’s capability around BIM was an indication to the group of how progressive they were. There were set expectations for BIM at the outset of the project, and they were later expanded to include preparing the model for facilities management.

The team used BIM and Navisworks in ways comparable to conventional projects and used the tools to focus more on preparing the model for facility management than for renovating Building 1. The team viewed BIM as valuable but generally felt that it was underutilized and did not impact the work significantly.

An outside firm was hired through Gensler to take the record files of Building 1 and assemble a core and envelope model in Revit that various teams would then be able to plug into. The model was discussed at the weekly design-PIT meeting. It was not seen as a strong design tool, in part because the sequence in which each team received the model in relation to where they were in the design process. The architect believes this work flow created the perception that entering information was “catching up.” TAI employed the Revit model in working with Sessa during the design process to develop better and cheaper approaches, and a refined model that could be used for fabrication drawings. Early on, they learned that the BIM based on the record files was not sufficient and more significant measuring of the existing building at certain locations was necessary; they employed this lesson learned on Building 2. The team used Navisworks for clash detection during construction, and it had some impact on the work. Generally, the use of BIM and the process around it was comparable to use on non-IPD projects, yet Turner did see that it “threw people together and made it much

more collaborative.” The team intended to improve the effectiveness of using BIM in Building 2.

The team ultimately delivered a comprehensive BIM to T. Rowe for facilities use. There was a significant amount of discussion at the end of the project around model delivery, with questions related to how it would be accessed and what information needed to be imbedded. The team worked on the final delivery of the models several months after the completion of the project to meet the owner’s expectations on how T. Rowe’s facilities staff intended to use it. According to TAI, “It’s been a learning process for the owner, for T. Rowe, as well as ourselves.”

- BIM was used effectively for coordination and clash detection, but the team felt that BIM was not fully utilized for design and construction.
- The goal of using BIM for facilities management was added late in the process.

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Workplace

The Building 1 team did not have a formal co-location strategy and identified the lack of co-location as a weak point, something that was continuously discussed and attempted on the project but not resolved. Virtual file sharing was effective for the team but did not make up for the lack of physical space to collaborate. The initial Big Room was located in Building 1, moved frequently to various locations throughout the building, and had limited effectiveness. The team met in Building 1 once a week on Wednesdays, but would often get bounced between conference rooms and was without a dedicated space during construction. The team had a mobile wall with sticky notes and pull planning diagrams. For Poole & Kent, “The process was happening, but it was very inconvenient and inefficient.” According to Gensler, “Everybody was grappling with how you make [co-location] effective, how you co-locate, and a part of that just fundamentally comes down to how people work. Architects work very differently in their process than MEP. We skirted around the critical co-location component of the project, but as we migrated into Building 2, we saw it improve, which is one of the lessons learned.” For Turner, “We struggled with how could people co-located,” especially for small projects like this one after which project team members might work together again on another project.

For Building 2, the owner pushed for a trailer with the hope that it would help the team bond. The team met there every Tuesday for several months and worked together according to a schedule set by Gensler. Haworth agreed, “A part of the learning that we had between Building 1 and Building 2 is that you need a committed space where you can leave stuff up. That sets the tone for the Big Room.” The team saw the benefits, attributing the change from twelve weeks of

design on Building 1 to eight weeks for Building 2 to partial co-location in the trailer. For future projects, the team is discussing true co-location, with a dedicated space for visual management from the beginning of the project.

The architects believed that the team would have benefited from talking with others who had experience with Big Rooms. The architect senior manager offered a lesson learned that “having more intentional discussions with others who have gone through it before, who could say ‘This is how we did it,’ as opposed to [just saying] ‘This is the Big Room,’ would have been beneficial.”

The team believed the lack of dedicated space for co-location led to inefficiencies and would highly recommend making a commitment to “true co-location” on future projects.

- Co-location was regarded as highly effective later in the project but of limited value in the early stages since there was no dedicated space to mount visual documents.
- The team believes that they should have put in more thought into the role of the Big Room and set goals for how it could best support their work.

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Team Alignment

By having key subcontractors involved early, the mechanical engineer from TAI saw more collaboration between themselves and the mechanical and electrical subs than on any other project. The conversations they had helped inform the design, especially as related to cost. With the whole team, instead of trying to protect their own turf and viewing problems as the responsibility of others, they saw that “everyone took their gloves off and just figured out the problem to solve it.”

The familiarity with the business practices of the partnering firms was considered by some to be a liability or vulnerable point because their internal practices would be revealed. However, it also formed the foundation for a particular instance in which one team member was able to recognize a misalignment with another firm’s business model. The team member noted regular mismatches in another firm regarding the number personnel employed compared to what had been planned. The team member spoke up in spite of some discomfort in stepping outside his conventional role: “They were doing a lot of overtime. I said to the superintendent, ‘Are you guys really okay on this budget? You’re doing Saturday and Sundays, forty guys, and I’m looking at it from the point of view that this is my money too.’” The trade partner who made the comment said that he would not have spoken up on a traditional project. But in this case, he had additional knowledge (that the hours didn’t make sense), and the team culture allowed for anyone to speak up about anything that could impact the project, regardless of traditional roles and boundaries. The superintendent realized that not only was their base budget incorrect (it did not follow the conventions set up by the team to include overhead), their project manager had been responding to additional work by adding additional personnel without factoring in the overhead costs.

The omission resulted in a difference of over \$200,000. After an analysis of the costs, some were attributed to owner change and some was eventually recouped when the reward pool was released. While the trade partner signatory would have been justified to ask for entire funds from the ICL, they believed they were at fault for the majority of the costs and covered the balance of over \$150,000. They reasoned, “The project contingency was exhausted during a previous issue caused by an unaccounted furniture tax. We took the position that we would not pull from the other team member’s incentive compensation layers, as long as any future project savings could possibly be applied toward the additional work we performed that had not been accounted for.”

The senior manager of the company that made the error believes that the IPD process was helpful in managing their error: “Our project manager should have caught this very early on in the process. We are very thankful for the IPD process and the fact that we were even able to recoup some of this issue.” From the owner’s perspective, the trade partner’s behavior was admirable: “[They] really stepped up to the plate, as it was a mistake that they could have had the project reimburse, and then said, ‘We got it; [we will cover the cost].’ So that was huge in my mind.” The other team members felt the situation was handled professionally because actions were taken immediately, and there “was full acceptance and an apology, a ‘This is how we’re going to fix it.’”

The team had a high level of focus on the budget and worked together to save costs. Continuous estimating was employed during design, ahead of the construction process. Financially, the hurdle for the teams was estimating from the base target to the final target. Challenged by the owner to determine which value-add items could be included, the team worked

together to specifically calculate, line by line, each value add. The owner had a contingency outside of the IPD contract, and it was transparent to the group.

The team scheduled key budget-performance reviews throughout the project to evaluate how each group was performing in meeting the goals for the project and their firm’s expected contribution to those goals.

Even if the project partners worked with similar IPD behaviors under a traditional format, the owner’s senior manager believed that without the multiparty agreement and liability waiver, you’re doing “IPD-like” and partners can still step away from the table when they are forced to protect their own interests. “It’s the contract that binds people together.”

- Some companies new to IPD found it completely compatible with their practices and enjoyed how it allowed their practice to have a greater impact than when using traditional delivery.
- The consultants were able to have more collaboration with trade partners.
- Familiarity with business practices between signatory partners supports collaboration but also can be seen as increasing companies’ vulnerability.

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Collaboration

The owner placed a high priority on defining scope items that could be value adds, and the process of working to find ways to incorporate the items into the project helped to align the team. Haworth saw this process as “an example of a very involved owner with a very clear understanding as to what he wanted, and we all respected that.” At the beginning of the project, the team set up dates when they would need to have an answer for each value-add item, so they could incorporate them without incurring rework or extra cost. As the team got more information on their costs through the course of the project, unspent funds were added back to project budget, and the owner would select how to utilize the funds and which value-add items would become incorporated.

Several project team members defined goals in addition to the owners’ stated objectives. For example, Gensler set a goal “to end up with an integrated unified campus that continues to look and support its employees in the right way.” For Turner, they felt the conditions of satisfaction, in terms of budget, did not indicate a specific numerical or percentage reduction but that the goal was to be generally under the previously established budgets for typical T. Rowe buildings. The team also understood the consequences of exceeding their fee: “Our ICL [risk/reward pool] would get eroded....So we were motivated to recoup as much of that profit layer as we could.”

In retrospect, Gensler saw the benefit of having team members at the table early in the process: “Having all of those entities at the table to cross-pollinate what we were trying to do and inform us as to methodologies and efficiencies was certainly something that we saw as a plus. We miss that now on other projects.” They remarked that the team was slow early in the project as they were figuring out these new ways of collaborating, but it eventually reached an efficiency

that matched optimal outcomes seen on the best of their traditionally delivered projects.

According to Turner’s project manager, early on, “trying to come up with the forms and budget reports and things like that and just getting the whole team up to speed with how the delivery method varies from others” was a challenge because of the IPD inexperience of the team, but it was not hard to overcome once everyone became engaged. Turner took the lead in developing tracking mechanisms and compilations based off of Turner templates from other IPD projects. Turner’s project manager viewed the IPD process as similar to the typical process but with more information, and managing the additional information was a different—rather than more difficult. They also saw value in being able to incorporate changes, especially value-added incentive items, without extending the schedule or cost.

Through early and extensive coordination among team members, including the sheet-metal contractor, the team was able to achieve the design goal of nine-foot ceilings. The team estimated that accommodating all the mechanical services in a tight plenum space typically would have quadrupled the cost. In this case, the coordination allowed the team to achieve their goal without additional cost.

Another area of coordination was around IT in the building. T. Rowe’s core business requires continuous IT connection; it was a critical project goal to maintain service during construction. The team resolved several issues regarding significant complications in the main IT room within Building 1 that affected all five buildings on the campus.

After completing the project, the project team viewed the Building 1 project as less adversarial than non-IPD projects,

and they attribute the positive culture to the ways they worked to resolve issues as a team. The owner felt more comfortable being involved with this team compared to previous experiences, yet he and the other SMT members question if they were as engaged or helpful as they could have been, or adding the right value: “How do we stay engaged and offer guidance throughout the project without being a decision-maker? How do we find that balance?”

The team viewed the Building 1 project as a test for the Building 2 project, and by the time they reached the three-quarter mark of Building 1, they felt confident with the promising results with which they would move forward into the next project. Seeing the success of Building 1, the owner received internal approval to do the Building 2 project using IPD. For the project team, pursuing IPD again was seen as a given. The owner’s SMT representative said, “It was a successful project, and the team is staying together.”

- The team was able to achieve many of the owner’s value-add items, managed by tying dates to critical decisions and using funds returned to the project.
- In spite of the learning curve involved in working with IPD, the architect thought the level of collaboration on this project was comparable with their most optimal traditionally delivered projects.
- Examples of intense collaboration allowed the team to meet challenging technical design goals.
- The team characterized their team culture as less adversarial than in traditional delivery.

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Team Culture

The team was unanimous in their positive view of their team’s culture. According to Turner, “Everyone was much more motivated to aid the success of everybody else since it directly impacted their success. The contract definitely did what it was supposed to do, incentivizing a team to collaborate and really take an interest in all of the other parties to ensure their success and, ultimately, the team success. There was much more open dialogue about opportunities for better ways of doing things. There were no adversarial relationships; everyone got along great. There was much more comfort in speaking up about any potential issues. People didn’t internalize problems as much as they typically do, since they knew that the rest of the team would just wait in trying to find a solution instead of pushing back or judging. I think that that really worked well and that was one of the great things about the IPD project.” While this comment sounds idyllic, it was consistently supported by the survey responses. Unanimously, respondents stated that others on the project team believed that collaboration was the key to reaching project goals.

The team felt comfortable with each other and developed good rapport within the first two months of the project. Turner’s project manager commented, “There was a feeling among people that you don’t want to necessarily be the one to voice bad news when you don’t have the relationship yet, but I think it quickly evolved.”

The PPC metrics recorded in the constraint log fostered healthy competition between team members. At the bottom of the constraint log was a bar graph of each team’s PPC performance, and each team was motivated to keep theirs the highest. For Gensler, “There was definitely prestige with being able to carry forward your percent complete when everybody could see it.” There was also competition between groups over

their percentage on the liability matrix, which kept track of finishing commitments by the agreed date.

With the monthly executive summary, the team celebrated achievement by doing a spotlight on success. Success ranged from meeting a date to a new way of doing something in the field.

For both design and construction, the PMT collectively came up with things that worked well and areas for improvement. They then took these lessons learned, summarized them by grouping them into primary and secondary items, and then met with the SMT to go through it as a group.

The team had outings that included holiday lunches and an end-of-project SMT versus PMT bowling challenge.

T. Rowe’s senior manager believes most valued benefit to IPD was his relationship with the project team: “The nicest part about it was no arguing, no finger pointing...It was really pleasant.” Reflecting back on the process, the owner saw that old behaviors would start to exhibit but then ebb: “They never manifested themselves like they have in the past. I wouldn’t say [they receded] because I stepped in, I thought that people just reminded themselves of the structure in which we’re operating—the agreement, the fact that we’re all in this together, we all rise with the tides. It’s not just somebody’s money, it’s everyone’s money at risk.”

- The team was extremely motivated by IPD and Lean goals across the board.
- The excitement to participate in an IPD project was evident in many areas.
- The tracking of improvement through some of the Lean processes was satisfying.
- The SMT, PMT, and PIT structure was laid out in the initial contract and evolved over time to include the right people at the right time.
- Financial transparency was challenging to achieve but yielded payoffs in positive team behaviors, such as mutual trust and willingness to speak up.

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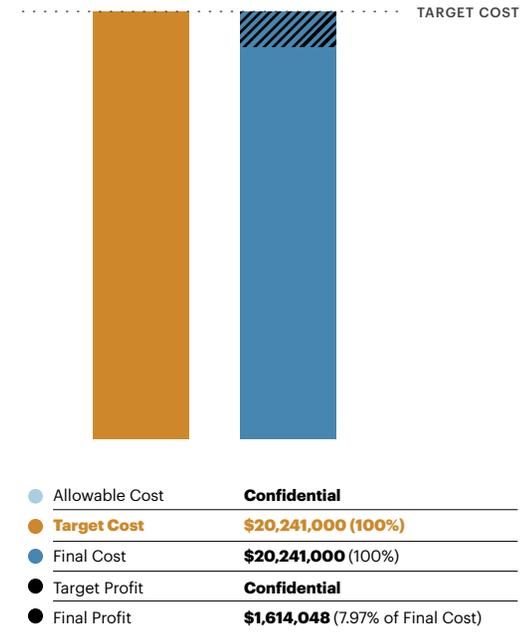
Profit & Payout

The total ICL was approximately \$1.7M of the \$17M final IPD budget.

The difference between base and final target costs was due to owner scope changes and change orders. The team understood the owner was keen on achieving cost certainty for the project. According to Gensler, the owner senior project manager communicated clearly that he did not want to approach T. Rowe’s management for additional funds for the project. The architect said, “I think it was a good thing for the owner not to have to go back and constantly hold his hand out for money as changes in the project were uncovered and discrepancies in the field arose.”

Beyond cost certainty, the team understood the owner’s goal of budget flexibility and early decision-making in order to include the value-add items. The contractor’s project manager said, “We were very cognizant of the fact that there were things that were not in the original budget that T. Rowe was hoping to get into the budget. Throughout the process of target value design, we were able to incorporate a lot of those items from the original base target cost up until the point of final target cost.” Between the base and final target costs, the IPD team was able to incorporate \$445,974 in value-added incentive items without increasing the project budget.

- The team was able to meet the owner’s goals for cost certainty and value-add items, and everyone benefited from the ICL.



T. ROWE PROJECT COSTS AND PROFIT

The final project cost of approximately \$20M was equal to the target cost. The \$1.6M profit final payout to the team was approximately 8% of the final project cost. The project contingency was utilized early on the project to cover unanticipated costs, and later, the project and owner contingencies went to value-add items.

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Budget & Schedule

One of the most significant value-add items was an alternate lighting scheme recommended by the architect and supported by the rest of the team. According to Gensler, “We took the opportunity to take something from a design standpoint that we felt strongly about and dive deeper into it, asking how we were trending [for the overall budget] and if this was something we wanted. If so, then we should make a contribution or see how we can help get it.” The owner and contractor discussed options, and the owner came up with a blended cost that used funds from the project contingency and the owner contingency. A couple of weeks before the drawings were due, the owner approved the change and it was incorporated.

Other large value-add items were to put stone tiles in many of the common spaces, which had a fifteen-week lead time, and to use glass walls, rather than solid walls, in the café areas. Turner’s project manager said, “We were able to incorporate [those changes] in the design phase because we were all at the table together, developing our budget as the design progressed, and we were able to find savings elsewhere that could be used.”

Just before Christmas, there was a schedule issue with a series of air conditioners, and it was resolved within a week. Once the issue presented itself, a conference call and meetings were scheduled, and during them the focus was on what was going to be done and not about pointing fingers. According to the owner, the most impressive aspect of how this issue was resolved was not how the team tapped their resources, which would likely have happened in a traditional delivery, “but it was the number of people who automatically stepped in. They didn’t have to be told to do it.”

The earliest test of the project team’s ability to manage problems was an issue involving taxes for a large item that had not been accounted for in the budget projection, attributed to the change in how taxes were handled during the project setup. The team saw it as a litmus test of their relationships. The Haworth representative to the SMT commented, “But even with [the spirit of collaboration], it was tense because nobody likes seeing that come out of their ICL.” Covering this cost exhausted the project contingency.

Another budget challenge arose very late in the project. An undersized circuit breaker had to be replaced, and it was discovered at the end of the project when half of the final ICL payment had already been made to the teams. There was high uncertainty about who would bear the cost. While the team was looking at redistributing some of the money already allocated to profit back to address the issue, the owner asked all of the team members to make their cases about what they believe were the contractual requirements of that particular issue, since the structure required the PMT to make a recommendation. The owner and others sensed a slight reversion in thinking from how things were approached during the project, and the issue brought up fundamental questions around liability with IPD. Turner questioned, “Later, when the contingency is gone, when we already took the money and cashed it at the bank, where does liability fall? Whose insurance steps in and deals with that? In a lot of cases, people are feeling their way through it. You have a good job; IPD’s great. You have a bad job; it gets tough.”

- In spite of budget challenges, the team was able to meet the overall goals for both budget and schedule.
- Several value-add items from the owner’s wish list were achieved within the overall budget.
- The budget for the project was lower than the previous T. Rowe buildings used as comparables.

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Building Outcomes

LEED was identified as one of the value metrics on the project related to Lean practices. Haworth saw that IPD made LEED a given: “If you follow IPD, LEED is an automatic. It’s a by-product.” The PMT managed the LEED process, and the SMT only became involved if Turner saw a deficiency. Poole & Kent saw the LEED scorecard as factoring in at several stages of the project. Early on, the team went through LEED and looked for opportunities. As the design progressed, they let go of strategies that didn’t work, and finally, they “used LEED a lot with construction methodologies and waste and planning and understanding the logistics of certain things.”

The energy project goals, stated in the October 2014 sustainability update issued by Gensler:

- Creating a healthy and safe work environment
- Reducing energy consumption and cost
- Reducing water consumption and cost
- Integrating green-maintenance practices for cleaning, lighting, and pest control
- Attaining LEED Commercial Interior v3 Silver

The team members worked to understand and meet standards before getting to the punch list. Turner and Poole & Kent put together preaction check-off lists to figure out problems and processes. For example, Poole & Kent noted, “We would talk with the field and ask, ‘How do we have to improve what our level of quality is here?’ They would discuss how to meet the standards of specific T. Rowe individuals, such as the IT person: “When he said he wants it clean, it’s almost cleaner than clean, even though you wouldn’t traditionally do that [level of quality]. So a lot of it was adjusting to his standards.”

A significant work-around on the project was a main IT room within Building 1, which serviced five buildings on the campus. The team understood that continuity of IT service was a key goal for the project, and this was one of several challenges they successfully navigated to stay live during the renovation.

The owner believed the team met their goals and that, overall, the project met its goals. T. Rowe’s senior manager remarked, “Most importantly, we have two very satisfied and happy and functioning [tenant] groups, and I continue to get good feedback....We deliver good spaces. IPD didn’t make this space how it looks, but IPD made a big difference in getting to this and how we spent our money.” This perception of higher value for investment is one important finding of this study.

- The team adapted to the sometimes-differing expectations within the owner group. For example, IT had extremely high standards.
- A major project goal was for IT continuity during construction and move-in; the team aligned to meet this goal.
- T. Rowe’s senior manager believes IPD “made a big difference on how we spend our money” to have an impact on the quality of the spaces.

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Project Credits

PROJECT TEAM

Signatory Pool

T. Rowe Price, Owner

Gensler, Architect

Turner Construction, Contractor

TAI, Engineer

Haworth, Trade Partner

Poole & Kent, Trade Partner

M.C. Dean, Trade Partner

+Risk/Reward Pool

Sessa Sheet Metal, Trade Partner

INTERVIEWEES

Owner (T. Rowe Price)

Brian Dean, Charlie Nugent (Facilities Management)

Architect (Gensler)

Jim Camp, Dan Jones

Contractor (Turner Construction)

Steve Beyer, Scott Bulera

MEP Engineer (TAI)

Brad Boutilier

Mechanical (Poole & Kent)

Donald Campbell, Glenn Meredith

Furniture (Haworth)

Lydia Knowles

Electrical (M.C. Dean)

William Knott

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T. ROWE PRICE OWINGS MILLS
CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION



Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

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WEKIVA SPRINGS CENTER EXPANSION

Project Description

PROJECT	Wekiva Springs Center Expansion
LOCATION	Jacksonville, FL
BUILDING TYPE	Healthcare
PROJECT TYPE	Renovation & New Addition
CONTRACT	ConsensusDocs 300
OWNER	UHS
ARCHITECT	Harvard Jolly
CONTRACTOR	Brasfield & Gorrie
PROJECT START	November 2012
COMPLETION	February 2015

Project Images



Photos provided courtesy of UHS

Project Delivery Experience



PROJECT PARTICIPANTS SURVEYED: 13

Though a few team members had prior experience in IPD and Lean, most were new to working with the processes and concepts. Some of the teams had worked together or with the owner on previous projects, but overall, this was the first project for this team.

Building Size 20,000 sq. ft.



Budget \$9,536,547



Schedule 4 months design 6 months construction



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Project Description

The large health care provider Universal Health Services (UHS) was interested in developing repeatable integrated project delivery (IPD) and Lean methods appropriate to what they categorize as small projects—in the budget range of \$10M to \$20M. Their project for Wekiva Springs Center in Jacksonville, Florida, was considered a model for testing rapid team start-up to execute IPD and Lean behaviors. The center, which remained open during construction, is a renovation that added approximately sixty beds to an existing facility. The owner, UHS, has been pursuing IPD and Lean on a number of projects, and this was one of a series of projects that contributed to learning and adapting practices. Although not all of their experiences have been positive, they continue to pursue IPD and Lean because the power of the delivery method is clear and they believe that they can continue to improve. Among the notable aspects of the project are:

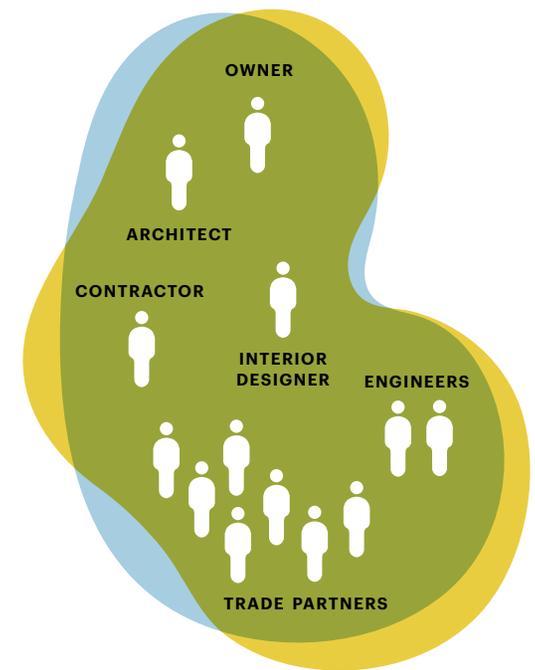
- Owner was experienced with IPD and Lean
- Higher use of Lean than other projects in this study
- Lean coach included as a member of the risk pool
- Verification process, not true validation
- Some prefabrication

PREVIOUS RELATIONSHIPS WITHIN PROJECT TEAM

The contractor company had a relationship with the owner, but the contractor's project manager did not and was also new to Lean and IPD. The contractor's project manager had not previously worked with the architect but did have experience with the mechanical and plumbing partner and the steel partner.

The project was the fourth that the architect had done with the owner. In comparing previous projects, he considered the Wekiva project team to be the most heavily involved with IPD. The architect had experience with the general contractor company. Because of the architect's earlier work, of similar program types with the owner, they already had a good understanding of the owner's objectives in terms of how they like to provide patient care.

The mechanical and plumbing partner had done several projects with the general contractor. They had also worked with the owner on one previous project, with the architect on a few projects, and with the engineer on many projects. They had not worked with the drywall or electrical contractors.



- ORIGINAL CONTRACT PARTIES / SIGNATORIES
- RISK / REWARD

WEKIVA SPRINGS PROJECT TEAM

There were a number of relationships that predated the project; however, not all of the project team members were familiar with each other. The Jacksonville area has a relatively small market and unfamiliar with IPD. The owner selected the architect first, then used an A3 process to select other team members. The process also incorporated input from the team members on board at that time. The signatory pool included the owner (UHS), the architect (Harvard Jolly), contractor (Brasfield & Gorrie), interior designer (In Design), two engineers, and seven trade partners.

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Project Timeline

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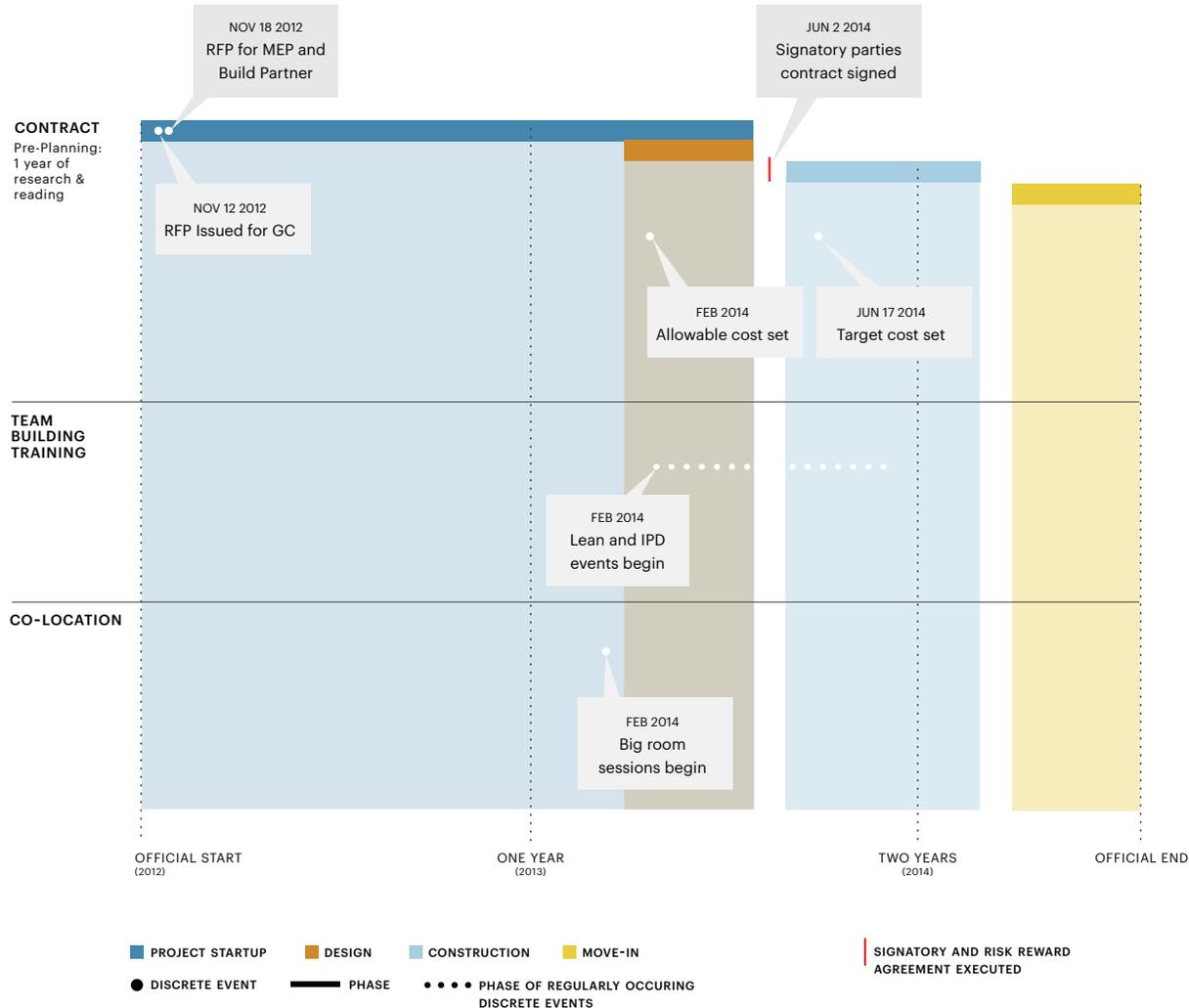
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WEKIVA SPRINGS PROJECT TIMELINE

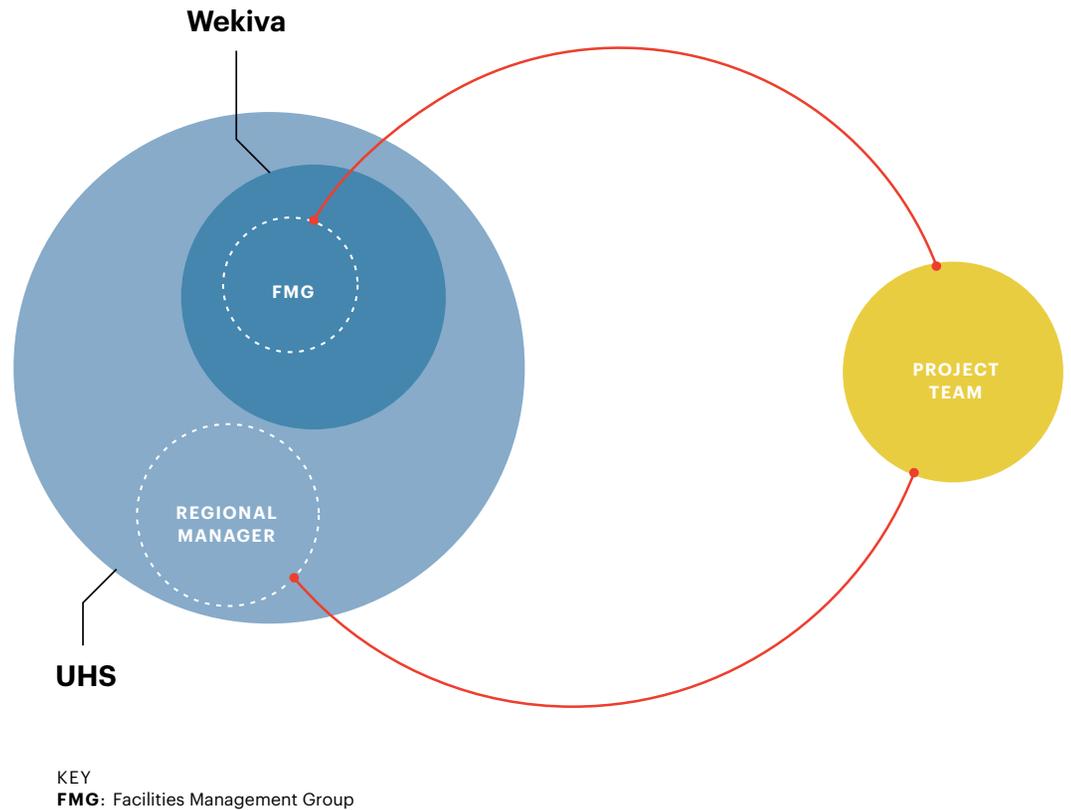
Since the project budget was approved before the team was finalized, the validation process was treated as a verification of feasibility. Early in the design process, CBA was used to upend the original assumption that the addition would be achieved by adding floors. Instead, a horizontal expansion was selected as the most advantageous. The owner considered early planning time to be a cost shift that would save funds during construction.

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Owner Identity & Interface

The owner characterized their business as stable, with deliberate, consistent growth, and that from an investment side tended to be a little conservative in terms of risks. They do not overleverage how much or how aggressively they expand or build. They try to maintain a steady growth rate and keep up with competition, especially in behavioral health, which they see as an explosive market in terms of need for patient beds at the time. They generally grow more through building new facilities or additions rather than by acquiring. They see themselves as traditionally having been lowest-first-cost-driven, building-code compliant, and "cheap," but having evolved to think more about best overall value. They are becoming more used to basing their business decisions on ROI evaluations, but sometimes still underbuild or overbuild when not focused on ROI.



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Choosing IPD & Lean

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The project was a renovation and expansion of an outdated health care facility. The owner said that the project had the typical complications that accompany construction when maintaining operations and working around patients and when working with the health care code-enforcement agencies on a renovation project. On the project, the owner perceived little risk, even though they had some tolerance for it. On a recent project they ran into major site issues, so they were not willing to take risk in terms of site.

This was the third Lean endeavor for the owner's project manager, who said, "It was really on the cusp of the learning curve from some painful experiences." They had to set expectations for the project based on the outcomes of another "IPD-ish" project with another owner that was wrapping up. Several of the core team members had been involved in that project, which had some negative team outcomes. "We were really looking to this project to see how could we take the lessons learned from a team-behavior and a Lean construction methodology that didn't go well on that previous project and make sure it does on this one."

The owner favors IPD compared to a traditional delivery method because "you have access to a lot more brainpower and resources to help you make the right decisions." He continued, "There's not as much requirement on the owner having to really prescriptively define in detail what we want early. We can be loose in terms of the details of what it looks like. You can say, 'Here is generally what we need,' and then leverage the team to really figure out what the right answer is for that need."

The owner described the reason he used IPD on this project: "As an owner we've been on the Lean and IPD journey now for a long time, or relatively long time. It's a growing evolution for

us to see what happens when we go into market areas where we haven't built before. Can we pull together a new team that we don't have experience with and that may not have IPD experience, and develop tools around rapidly growing that team into a high-functioning IPD group? I think that's why it's an ongoing journey."

The project team members clearly felt that the choice to use IPD and Lean on the project came from the owner. The contractor stated, "It's their delivery method. They've had a lot of success with it, they promote it, and they like to teach it. The decision on this project was already made before we were on board. But the client and delivery method of the project was something that had our attention. It made the project very appealing to us." According to the architect, "It wasn't our motivation or desire to promote that [IPD]."

The contractor's project manager did not have previous experience in Lean or IPD, but had positive experiences with design-build work. The idea of extending a tri-party working relationship to the trade partners with IPD was "very new." The MEP engineer did not have experience with Lean or IPD but looked at it as "an opportunity to grow and get experience in an area that we know is growing and want to be a part of." The process was new to them, and the interaction between the team exceeded anything they had had on previous projects: "It was very successful in my view. I think we accomplished what we tried to accomplish. Very challenging and very rewarding, and I enjoyed it and I learned."

- UHS has been on a Lean and IPD journey for many years, and they find great benefit in this delivery method.
- This was the third Lean endeavor for UHS's project manager, and it provided an opportunity to capitalize on lessons learned from previous experiences.
- The owner was interested in seeing if a project team inexperienced with Lean and IPD could be shaped into a high-functioning integrated team over the course of one project.

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Team Selection

Jacksonville has a smaller building-industry market than other areas where IPD is better known. In order to gain interest in this project, the owner recalled having “to reach out to some of the guys who trusted us already.” As he explained, “When work was starting to get busy again and there was a new delivery method, people are a little bit hesitant to jump in.”

The owner believed the selection of the architecture firm should come first, without the need to consult with other potential partners. After that choice was finalized, the owner created a selection team with representatives from the owner’s design and construction corporate group, leadership from the facility, and the architect. That group selected the general contractor and MEP trades, who were added to the selection team to form a core team that selected the remaining team members. The owner has a system for contract-party selections: “We go through a very simple A3 proposal format. We look for companies that share the right kind of cultural set up that would support what we’re trying to do, and then within those companies we look for individuals who have the right kind of attitude, behavior that will help us build an effective team that would lead to collaboration, that would help us create an innovative environment.” The owner also looked for conceptual budgeting from the contractors and how they can support target value design. They also looked at “industry standard stuff,” such as how the organization and the individuals approach safety.

There was a lot of conversation around the choice of MEP by the initial selection group. The owner recalled, “It turned out to be a really interesting phenomenon. The project manager for the mechanical outfit, an all-star on the team and a really strong supporter of the team and the team members, just didn’t interview well. We didn’t get a really good feel for his

involvement or his interest or capacity, but we ended up making a decision based on a prior experience of the facility. A little bit against our judgment based on what we saw in the interview room, but it ended up being a solid decision in the end.” The facility had not worked with the individual but had worked with the company, and knew that if the project manager was not the right individual, it could be worked out. The general contractor had also worked with him and “vouched for him as well.” This situation was included in the lessons learned in order to develop countermeasures against those who do not interview well.

The contractor said that team forming and team initiation was a large topic of discussion. “Retrospectively looking back at, for example, why John Doe turned out to be such a champion on a project and somebody else was not. How could we have gone back and tried to figure out that information during the interview in a different way? We talked a lot about that and how we would do it in the future, and how we’d improve it.”

The mechanical and plumbing partner recalled that all of the core team partners had an equal role in selecting the rest of the team, and “the interviews were heavily weighted toward Lean experience and what they could bring to the team in regards to new ways of doing things, focusing on finding better ways of doing things, not just doing the same old thing.” All of the trade partners who were in the profit-sharing pool were involved at the early planning stage.

The contractor described why they used cost criteria for most subcontractors and performance based for others: “We know the market [in Jacksonville], and so we could find a group of prequalified subcontractors to come up with a good list of guys and still make it a competitive environment to try to drive costs down. There were a couple subs that we brought on

based on performance or trust. One of them was the millwork contractor because one of the first things that happened was that the interior designer asked us to help bring on a millworker. Rather than bidding on shop drawings, we’d have our millworker on board to help develop those shop drawings to avoid that overlap.”

The architect respected the contractor’s robust on-boarding for all of the subcontractors. They reflected that their own on-boarding process for the consultants was not as effective as it could have been: “Conceptually, everything was well received and benefited the team, but I think in practice, I’m not so convinced that everything works the way it’s intended.”

- The owner believed the architecture firm should be identified first so they have input in selecting the rest of the team.
- UHS typically uses a proposal format modeled on the Lean A3 tool, in addition to typical criteria; the proposals are intended to reveal individuals who have an attitude of collaboration and innovation within companies who can support UHS’s culture.

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Developing Contract

Contract Type: ConsensusDocs 300 with modifications for multiparty and customized financial terms

The owner used a modified version of the ConsensusDocs 300 for the project. They adapted the template to be multiparty and formed their own financial-deal structure that focused the team around target costs, profit pools at risk, and a risk-management fund. The owner recalled, “I think the biggest impact of the contract was just the initial on-boarding, using it as a tool to explain why we’re all signing one contract and why the whole team needs to be focused around just one bucket of costs rather than individual team member contract amounts and cost. We used it to describe what goes badly when each team member has their own set dollar amount that they’re managing and that the key part of this contract is that we’re all focused on the overall project outcomes and objectives in terms of the total project cost. One team member can spend more if it saves somebody else more money, and that’s a benefit to everybody.”

The architect did not consider any aspects of the contract as difficult to manage because they had done something similar before using a conventional version of ConsensusDocs 300.

The contractor described some criticism to the contract: “We talked a lot about how we thought the contract was ridiculous in the sense that what we’re trying to do is make the project less contractual and more about having a trusted environment. And the contract is five times the length of our typical contracts, with five times the verbiage. I don’t know that that made it difficult to manage, but it would have made it difficult to manage in the event that there was ever a situation in which we had to go back to the contract.”

Since the Wekiva project, the owner has moved away from the ConsensusDocs 300 template to develop a customized contract that they pre-execute as a master agreement for the companies with which they do a lot of work. “The hope is that our project authorizations will require less paperwork and are more of an administrative thing that are easy to execute.”

- Financial terms were intended to focus the team on target cost, profit pools at risk, and a risk-management fund.
- The owner considered the contract’s primary importance as being an on-boarding tool, used for the team to align around total project costs instead of individual company contract amounts.
- Since this project, the owner has moved away from using Consensus Docs 300, developing a master agreement that can be pre-executed with companies who are frequent partners.

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Developing Parties

Overall, the owner believes they do not have a good methodology for deciding who is in the risk pool or the timing of their inclusion. The owner described the “ad-hoc” process used once a trade was identified as having an impact: “We tried to bring certain people in the earliest stage possible. We’ve struggled a little bit in the past with not really understanding how to do that and bringing everybody in at the beginning, which can cause some excess cost burn and burn out.” In this project, the owner knew they faced a decision to add floors or horizontally expand, those decisions “lent themselves right away to the MEP guys and the site guy.” By contrast, “we could defer drywall and some of the other trades.”

The contractor recalls the risk/reward–pool discussions were based on project needs: “We’ve got some decisions coming up. In order to make those decisions in the right way, we believe we need to have a mechanical on board.” The contractor recalled an inclusive process for decisions using round-table discussions. The potential trade partners went through a prequalification process; this allowed the core team to focus on finding the individual within that company who would be their primary Big Room contact. The team looked for indications that the person seemed willing to learn and be open to new ideas, not tied to a conventional delivery method. They also focused on how the companies handled labor tracking and productivity. The team was not interested in bringing on companies that would use third-party labor “because hiring contract managers wasn’t going to influence our project and allow us to take advantage of [having] trade partners.”

On the project, the owner approved their funding amount without a validation study but wanted the team to go through

a verification process to give the team confidence that they could “build what we wanted to build for the dollar amount that we wanted.” The owner describes the process as a way for the team to link the “big, big ticket design decisions” to risks related to factors involved in those decisions. He also believed the process established “team member accountability around project-cost projections. It created ownership within the new team members, that they owned certain cost projections.” The owner characterized the verification process: It started with a list of current cost projection, risks, and add-back items “that showed us a path on how to get [to the target cost]. A lot of it was conversational—as we were going into estimates and cost projections, there were ideas that the team members talked about that hadn’t been baked into their numbers yet. There was still some contingency and conservative numbers in some of the initial estimates. Between that and ideas that had yet to be vetted out, there was a pretty good team feeling that we were heading in the right direction.”

This team took the unusual step of including the Lean and IPD facilitator in the profit pool. Their rationale was that the coach should be invested in the outcome and feel confident that their work with the team would lead to project success.

Though the owner still has each team member carry their own insurance and liability insurance on smaller projects, contractually, the whole team owned the risk. The owner described this: “There’s not a traditional errors and omissions because we bring the team in at the beginning, and they’re sitting right there with the design team. There’s no pushing design-document risk out, and the team knows what they need to build even if it’s not documented on the drawing, whereas in a traditional method, they could push back and say that’s the designer’s liability or the owner’s liability.” His

belief is that in IPD, errors and omissions are covered by the owner, so their only impact “is an erosion of profit pool.” While this expansive view of liability supports IPD, knowledge did not seem widespread within the team. For example, the contractor did not remember anything different from a typical delivery regarding insurance or liability waivers on the project.

The core team created the profit pool based on the companies whose work could influence the project, primarily those with larger or more complicated contracts. The team also discussed that being involved in the Big Room took significant time, and as a result, the cost for companies with lower level of involvement would be higher than their expected impact. The profit pool was shared based on terms named in the contract, with all companies being paid their costs and overhead. Any company included in the profit pool was guaranteed cost plus overhead on the project and profit pool when the project cost was below the target cost, split according to an agreed upon percentage. The profit pool could increase by up to an additional 50% if risk-mitigation funds were not used.

- The owner determined inclusion in the risk/reward pool based on the core team’s perception of project need.
- The team took an unusual step to include the Lean/IPD facilitator in the risk/reward pool.
- The owner funding was set before the project start; a verification process was used to give the team confidence that the goals were feasible.
- The owner assumed the risk for errors and omissions traditionally pushed to designers.

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Champions

Several members of the team pointed to the owner as the main champion for IPD and Lean, with strong support from the contractor and interior designer. The project manager within the owner group spoke to this: “My path to the role I’m in now with UHS really was driven by an interest in this kind of project delivery [Lean and IPD] and seeing an owner who was at the forefront of pushing that kind of project delivery and honestly ‘walking the walk’ of how to do this on these types of projects. I probably wouldn’t be at UHS if we weren’t approaching our projects in an integrated fashion.” The architect saw IPD as a part of the owner’s culture and plans on doing future IPD projects with them. The contractor considered the owner’s project manager to be a leading champion for IPD and also brought in two of their own people who had experience working with the owner’s project manager as Lean champions.

The MEP engineer was excited by the process and as a company are now looking into revising some of the ways they do things to incorporate more Lean philosophies: “We’re actually developing a group in town here to try to present to owners some more Lean opportunities and just have been really challenged and enjoyed it.” The MEP engineer would do IPD and Lean again “in a heartbeat.” But he indicated an area of adjustment: “What I would do differently is maybe focus more up front on Last Planner System and developing the team’s abilities there and understanding, nailing down a single way to do it so you can be more effective. Our scheduling was a struggle.”

The contractor is now a proponent of IPD and Lean and definitely “a promoter of the delivery method.” He stated that “there were lots of things that we learned that we would do differently. But I don’t think any of them were problematic. It

was more about improving ‘10% on this and 10% on that’ than trying to do something just totally differently.”

The architect said, “I believe this project ran more efficiently than past projects, but I’m going to qualify that by saying that I think it was more challenging from the design aspect.” They expanded by talking about pull planning: “I believe that, in concept, it works very well. There is a lot of room for improvement on this project, and there were some misunderstanding. I can break it down into two ways: this system works very well and is very refined, and it’s easily quantifiable in the construction and costing and scheduling aspects, but the nature of design does not lend itself as easily to pull planning and that type of process that’s adopted by integrated project delivery.”

On future projects, the architect would adjust for the order and speed with which design occurs. The architect recounts the phrase often used to describe the pace of IPD projects, “Go slow to go fast,” and observed that “while I recognize it in concept, in this project—of the several we’ve done for this owner—that the phrase was most apparent when [the process] worked well but also when it was not working well.” Though the architect thought that many components of IPD, including “some of the techniques, some of the studies, some of the tools for decision-making, absolutely” are valuable to a design firm, he added, “As far as buying wholesale, the entire process, I’m not convinced.”

- The team perceived the owner as the primary champion for both Lean and IPD.
- Most of the team is enthusiastic about IPD; the architect remained ambivalent about its value.

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Decision Structure

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The contractor described how they learned to navigate a different relationship with the trade partners: “The first [step] was, ‘I need to act in a way that communicates that our vote is no [more] important than their vote and that our opinion is no more important than theirs.’” The second realization was that trade partners are not typically expected to be proactive, “and there were things that were slipping through the cracks because we were trying to give them the space to take care of it themselves. It just wasn’t hitting them that they needed to be thinking about that, because they’re so used to information being asked of them on a regular basis. We had to find a balance to avoid letting them fail because they were waiting for us to ask them for things.”

Every meeting a different team member served as facilitator. The contractor thought this “was a great experience for a lot of the people, from a standpoint of starting to understand what it’s like to be running that meeting, in terms of personal development, but also building sensitivity about what it means when somebody else is facilitating, so that each individual is more effective in meetings.”

The architect thought that the system for the decision-making process was very well organized. “We’d list objectives. Choosing by Advantages (CBA) was kind of a new concept for me, the way that’s formatted. But there was no arguing. It was very productive and it moved forward very well.”

The mechanical and plumbing contractor also thought that the decision-making process unique. “It was heavily CBA-based during design. It also heavily leaned on guidance from the owner. There were some challenges as far as adopting the Lean way of scheduling and planning scheduling in terms of the [design] partners’ regular way

of doing design development drawings, permit drawings, construction drawings.” They went on to say, “We tried to identify constraints early through pull planning and meet the challenges of that ahead of time, which was somewhat successful, somewhat not.”

The owner gave an example of the powerful impact that CBA had on the project. The owner’s group started the project with the assumption that because the building’s structure had been designed to support additional floors, the logical expansion strategy would be vertical. “But we made sure to let the team ask the question as to whether that was the right answer. The outcome of that CBA was that we should expand horizontally. That led into a second CBA to determine in which direction we should expand. The one that was chosen in the end was interesting because it had originally been added to the list but had been generally assumed to not be viable.” The architect thought that CBA was an added value “because it formalized in a process, something that we, as designers, do all the time, but more intuitively and not necessarily consistently in the same way, and that this provided a framework for that type of decision-making.” They also considered reliable promising to be prevalent and encouraged. “Through pressure, everyone expected [reliability] from the others, and it made each individual want to meet their obligations. So I think that was a positive.”

Although the architect was skeptical about how design benefited through many of the Lean processes (pull planning in particular), he thought that some aspects of the process could improve design. “First of all, many times in the typical [delivery] model, we inflict details or systems onto the project and then it’s a matter of finding how cheaply you can do it. Whereas in this [IPD/Lean] model everyone is involved in

the design process, so they can offer alternative systems or details, and we can talk through the benefits or merits of one system versus the other, not just in isolation but how it might affect other aspects of the design. The sum of that is that you end up with a more refined design and one that’s more sensitive to the overall cost, not just isolated costs and how that might affect schedule.”

- The contractor formed an unconventional relationship with their trade partners.
- The meeting-facilitator role rotated, which promoted appreciation of effective meetings.
- Choosing by Advantages challenged a fundamental assumption about the expansion strategy.
- The architect appreciated the collaborative input but found times when sequence and timing of decisions was not beneficial to design.

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On Board & Off Board

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The mechanical and plumbing partner said, “We put together an on-boarding plan. Each person who came on to the job went through our on-boarding process, which involved a video and a presentation to introduce them to the Lean concepts that we were using, trying to focus on getting them to buy in to being able to offer feedback and provide ideas and thoughts. A couple of times, we did surveys to get feedback from the field to see how we thought they were adapting to that new way of thinking.”

The architect said, “The on-boarding explained the [IPD] process to the team as the team was formed. [Those doing the on-boarding] recognized and appreciated that they couldn’t expect everyone [on the team] to know [IPD and Lean] going in, and they took a lot of time to try and explain the concepts to those of us that had some knowledge as well as to those that had none.”

The contractor said they did a little bit around team health and breakdowns and had what they called team-health-check calls. “We definitely had an intention to make sure that when there was a question of accountability for the team, or frustration within the team, that they would be on the team-health call with the primary stakeholders on the project, and they could ask for a breakdown and talk it out. Ultimately, there were a lot of good, open conversations. There were still situations in which it didn’t have any influence...but it was nice to know that people could talk about it.” The team-health checks revealed at least two instances of partners who were not performing as well as expected. The type of behavior—“not fully engaging at the level that the team thought was necessary and proactively identifying constraints”—of low-performing partners had consequences: delays.

The owner said, “Nothing resulted in removing a team member, but we had some team-health conversations about the issues and the expectation of how you need to be engaged and behave in a Big Room, and that if that’s not possible, then we’ll need to go to another step. Lesson learned for us was to do that as soon as we recognized an issue in the project.”

The whole team was part of the conversations around team health and the need for specific behavior changes. The owner perceived these as successful discussions that led to positive change. “We didn’t really get any pushback or negativity around it. One of the things we did well in that regard is that we had our Lean coach participate in those conversations. We had a neutral, not engaged in the day-to-day project activities, facilitator to help. That helped lend some neutrality and didn’t make it personal.”

Based on a core-strength-profile analysis at the beginning of the project, the team assigned a champion to team health who was very interested in the topic but happened to be primarily involved with the preconstruction phase. The owner explained, “We didn’t take the step of putting somebody else in that role when their engagement waned toward the end the preconstruction phase. There wasn’t a good handoff. We focused on team health and team dynamics in the beginning but then reassigned the champion role to somebody else who would stay engaged, so we fell off the radar a little bit.”

- Regular presentations made on-boarding consistent; surveys tested its effectiveness.
- Team health checks were effective, although they could have been used more regularly.
- Health checks led to early identification of performance issues.
- The participation of the Lean coaches helped keep the conversations neutral and constructive.

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Clarity of Goals

The owner thought that their goals were clearly communicated to the team, “not in a single instant but in a process to get to establishing the goals.” The owner and the team engaged facility users to discover their product-based and operational-based conditions, and from the user input created a conditions of satisfaction document for the project. The owner saw that their business objectives in the end were measured based on the final cost and the viability of the program, and said, “The softer objectives we defined with the team and with the end users in the facility and how well the environment supports the objectives are more subjective gauges of how well we did against things like balancing some design tensions, like, Is it a safe environment? Is it durable yet? Is it a noninstitutional, aesthetically pleasing, and healing environment? We talked a lot about those sorts of objectives in the design stage to see how we could balance those things.” The owner saw that though some of their established goals were actionable and measurable, some were softer and not easily measured: “We don’t have a good way of measuring the [goals] in terms of the interior feeling of the space. It’s more about walking the space and if, in the end, we feel like we hit the right balance point.”

The owner also had more broad goals related to IPD. “We had some team-learning objectives around becoming net exporters of knowledge, which is a concept we introduced to the team, a fairly new team to IPD. At the beginning there was a lot of importing of knowledge. By the end of the project we wanted the team to be able to export some knowledge and share that with the community.”

The contractor said, “The owners’ goals were clear to us, but they intentionally let us set the deliverable relative to what we thought was a realistic number, what we thought the date

would be. Their goal there was more about an accurate date and less about giving us a deadline. It’s more about being able to plan around the date.” The contractor said that the owner’s goals were developed in the conditions of satisfaction, and everyone had the owner project requirements (OPR) for the program, which was the primary basis for the goals. In addition, the contractor believed the owner’s project manager provided context for less explicit goals that might relate to enterprise-wide benchmarks or industry trends.

The architect thought that the goals were very clear. When the project began, a robust program had already been developed, so they knew what the objectives were. The architect saw a part of their role as getting input from both the owner’s project manager, who was a proponent of the day-to-day efforts, and the owner’s end-user groups, such as the CEO of the facility, so that the design could incorporate feedback and stay on track. The architect also mentioned that internal UHS discussions led to a change in the goals regarding some units. This caused some challenges, “but they were done in a timely manner, and they were presented in such a way that they didn’t want to wholesale change everything. They wanted to see how we might incorporate these changes with what was already in place.”

The MEP engineer thought the owner’s goals were clear and were “pretty consistent” over the life of the project.

- The owner invested in communicating their goals over a period of time, including engagement of building users, to develop the conditions of satisfaction.
- The owner had broader goals beyond the business and program goals of the project. They expected the team to be a “net exporter” of IPD knowledge.
- The contractor commented that the owner’s goals were clear, and the team was encouraged to define the schedule and subgoals.

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Resources & Facilitation

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The team engaged the Lean coach as a profit-at-risk member, so the coach had a stake in the outcome of the project. According to the owner, the coach “could participate with the team not just as a consultant but as an advocate and really make decisions on how much engagement could be useful and beneficial.”

The owner focused most heavily on on-boarding: “We emphasized how we take a team and how much energy and resources we expended on creating the organization of the team and doing the on-boarding in the coaching with the initial early stakeholder core team, but also all the way through Last Planner and even field implementation.” The owner said that they did more with assessment and team health at the beginning of the project, that it fell off somewhat later on. “That’s a lesson learned, that we need to stay on that and be consistent with that through the life of the project. Even the work we did on that in the beginning had a major impact. The self-assessments actually built understanding of each other within the team and of what each team member brings to the table. Not just getting my expert point of view, but seeing how they approach things and what makes them tick was very helpful in creating a good dialogue within the team, and letting us interact better.” The owner attributes the early team-health checks with identifying performance issues early enough for intervention to be effective.

The team did several assessments, and some self-assessments were included in the conditions of satisfaction. A coach who used Core Clarity system, based on Gallup’s StrengthsFinder assessment, was brought in to evaluate individual team member’s approach to goals and anticipate potential conflicts. The team also used Lean Construction Institute publications to do targeted coaching around team dynamics, team health,

effective meetings, and around deliverables, target value design, how to design with cost in mind.

The owner thought assessment was a value add for the team. “It was a novelty at the beginning, but as we went through the coaching, we did two things: We started with on-boarding around what it is and what it means, and talking through each person’s core strengths. But then we actually applied it in a practical sense, keeping our coach engaged while we were doing actual Big Room tasks—while we were pull planning, while we were doing budget updates.” The contractor found the strengths assessments to be “incredibly useful”: “The assessments did a really good job of summarizing the strengths in a way that was usable and simple to remember for each individual person. For example, one of mine was ‘very achievement-oriented’—how might that be perceived by somebody who is more creative and thinking-oriented in terms of me trying to go too fast.”

The mechanical and plumbing contractor said that going through the Core Clarity exercise as a team was valuable, “since lot of the team didn’t know each other, it enabled us to be a little closer as a team, learn about each other and learn what makes people think the way they think.”

The architect was skeptical about the benefits of the team building. He noted that while some exercises were valuable “that perhaps there was too much emphasizes on the concept of it versus allowing that type of interaction to actually occur on the team.” He continued, “In other words, they bought in some consultants who talked about interpersonal dynamics and this, that, and the other, and while that’s very interesting, I didn’t see that that ultimately added or changed anything other than taking up resources and time.”

The contractor commented that Last Planner became a tangible way to focus the energy generated during early Lean and IPD training, that it was “the one thing that our field leaders could grasp in terms of trying, adjusting, and really implementing.” Yet, there were challenges with the process. In hindsight, the contractor would have established a baseline from which to make their project-specific adjustments. “For people who have never jumped into it before, there were a too many different opinions as to how it was to be done. As a result, the field members lacked some confidence in what we were doing because there continued to be some pretty major opinions as to how do things a little bit differently.”

- The owner invested most heavily in facilitation early in the process.
- Self-assessment process included StrengthsFinder and Core Clarity.
- Lean training included several publications produced by the Lean Construction Institute.
- Assessment and training were valuable for most team members, except for the architect.
- Team-health checks were very effective but were not done consistently.
- The contractor commented that for Lean and Last Planner, “there were too many different opinions as to how it was to be done.”

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Tools & Processes

The consistency of use and range of tools employed by the team was especially impressive given the lack of Lean experience on the team. The architect said, "I remember almost any decision or any effort that we were putting forward as a team involved [Lean] tools." A trade partner said the project was "challenging because of the fact that most of the team had not been a part of a Lean project before."

The team consistently used Last Planner, which the owner described: "We started that in design, and even in the design stages we tried to use a form of Last Planner in milestone planning and pull planning to establish our design work flow and our information handoffs. One of the things we learned was that in design we really should be focusing those things on questions that needed to be answered and when those questions need to be answered to see if we're on track." The mechanical and plumbing contractor noted challenges from having so few team members experienced with pull planning: "It was extremely challenging on the preconstruction side of things. Getting the engineers and architects to break things down into individual pieces as opposed to just doing their normal daily flow was a challenge." The owner observed that while Last Planner tools, like plan percent complete (PPC), tracked reliable promising, there was not "a real measuring tool generally for accountability."

The contractor felt, as a team "we did a really good job of being diligent about tracking. Not having just general open buckets of contingency but really evaluating them relative to a risk, a specific risk, a countermeasure to that risk, and checking those items off as we went along." Regarding the shared cost-tracking tool, the owner said, "We had pretty good luck in getting the team coached on how it's used and why." He described their process: "Each team member

comes into the team Big Room with their own estimating or budget-update or cost-projection tools. Then we've got this team-tracking mechanism that lets us not just [track] status changes in the working estimate at any given time but also has all of our risk and path-back register [list of changes that may be used to stay on target cost], as well as wish-list items."

The contractor noted that the design team had more of a struggle with target value design than the construction partners: "Old habits die hard. I think that there were too many excuses as they went through it, as to why they couldn't take feedback from the construction team into the design." The architect outlined their biggest issue: "It was forcing the design team to pull plan something that doesn't really lend itself to pull planning. The way to track the way design evolves and develops is fundamentally different than how a contractor can easily quantify the man-hours that it takes to hang drywall and how many days that's going to take. I can use an analogy for design—it's almost like developing a photograph, everything is developing all at once, not one single thing is developed before the other. It all evolves and morphs, and there is a lot of happening in all areas at the same time. And pull planning wants it to be the opposite. It wants you to break down to definitive, separate things and quantify times associated with a specific, finite, very small part of the design, and that was very frustrating to try and work through. In this project's case, the time spent trying to force that was ultimately a negative and ended up wasting a lot of time."

The architect thought that tools used related to cost and design decision-making were successful, with the exception of the cluster groups. "I think cluster groups in concept are fine, but it seemed as though regardless of what the question or the problem was, it was immediately assumed that a cluster

group would be formed and everyone would do a pull plan and put hundreds of post-it notes up. In my opinion, some cases could usually be settled in about five minutes by just talking about it, but it was almost as though there was an insistence that you follow rigidly this format regardless of whether it was appropriate or not."

The mechanical and plumbing contractor discussed productivity analysis. "We had each partner identify a series of items that we could track, [in terms of] productivity, and tried to adjust as we went through the project based on those results, which mined some good information. I don't know how much adjustment ended up happening, simply because the project was so quick that there wasn't really time to drop back, adjust, and restart something differently."

- There was extensive and various tools used by a team with varied Lean experience.
- Using Last Planner, the team found it was challenging to get architects and engineers to "break things down" instead of following their typical flow of work.

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Lean Effectiveness

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The owner's expectations with Lean were not entirely met on the project. "In terms of actual Lean construction and extracting waste out of the construction process, we still have a ways to go. We partially hit the mark on this. We implemented some solid things as ground rules from what we had just learned as the basics to keep the project Lean and efficient, but we didn't get to the point where we were actually tapping the creativity of the team members in the field to make improvements to the process as we were going through."

The owner thought the creation of the weekly work plan was done well, but it was difficult to have it consistently followed in the field: "There's still a tendency for people to go and make do and do whatever they can once they get out on the slab and actually start doing work." He noted that Lean field practices were effective: "We really pushed on things, like no trash hitting the ground, minimizing inventory and what inventory and tools need to be on wheels. We pushed on having no electrical cords on the ground. We carved the project up into batches and had visual identifiers of batch areas so we could relate those back to the pull plan."

The owner has tracked lessons learned on projects predating Wekiva through retrospective A3 summaries and surveys on multiple projects. The retrospectives and surveys ask what the owner and team should "keep/stop/start doing," what could have been done differently, and gather specific feedback metrics around project schedule, project cost, design support during construction, and the construction process. They have added a retrospective document from Wekiva to their resources and are using the collective lessons to make changes to their next project. The project team includes several members of the Wekiva team, including the architect.

The team had some discussions around misses. They had a few design issues that were significant enough that they invested time as a group to do 5 Whys (root-cause analysis) at the end of the construction process. In addition to the construction retrospectives, the owner said that they also did a target value design retrospective "because we made a lot of design decisions—'Can it be in or not?'—in terms of value based on our expectation of cost, not reality. We looked back at the end and tried to figure out if we balanced that or if we left money or value on the table." The team used Plus/Deltas in all of the Big Room sessions, and the owner observed, "I think we probably weren't as effective as we could have been in designing countermeasures to all the Deltas." The contractor said they attempted to develop a dashboard, but "unfortunately, in a project of this size, it became a big burden that fell off of the priorities list."

Several A3s were completed: to study prefabrication options, during bathroom design (sink types, etc.), and a few that were product-based. The owner said, "When the team gets far enough through the validation, to a concept stage, we do a project A3 that summarizes the program, the layout, the flow of patients and staff, and major cost buckets so we have an executive-summary A3."

- Although this team implemented more Lean tools than others in this study, the owner believed their Lean goals were not met since "we didn't get to the point where we actually tapped the creativity of the team members in the field."

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BIM

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The owner said that they did not set any specific expectations for building information modeling (BIM) in the project, and they did not plan to use the model for facility management. They have found that the buildings they own are not sophisticated enough to warrant its use. BIM and its expected use was communicated verbally to the team during the kickoff; it was an agenda item during one of the early Big Rooms discussions about how they would communicate in design, how they would structure handoffs, and what the requirements were. The owner said, "We didn't have any predetermined requirements, so it was just a discussion of what we, as a team, could figure out as making the most sense for us in a working environment." The owner's statements to the team were that they could use 3-D modeling when it made sense and for fabrication as needed. For prefabricated elements that were heavily coordinated between multiple trades 3-D modeling was done, but, overall, the team did not heavily rely on 3-D modeling. Some team members did their work in 2-D.

The owner thought that BIM supported prefab, but the team did not take advantage of its potential for user visualization. "We haven't done much yet with finished-space modeling from how the end users would experience it. That's something we could do a lot more with. That requires a little bit more work because you actually have to model the furnishings and the equipment and everything to give them that true experience, but there would be a big benefit to that as a virtual markup of the space that the end users can walk through. That's, for us, an untapped area for modeling."

The contractor did not use BIM. From the early conversation on, they believed that one of the major contributing factors to

that decision was the relatively small size of the project as well as the fact that it was an expansion to an existing facility.

The architect thought that a "part of the problem with an expansion is that you're dealing with the existing portion of the building, and in order to model that in BIM, simply to get a background to start working off of, would be time and cost prohibitive." They expressed, "We are finding in our own practice in general that the weak point of BIM is that it seems to require much more effort put in for something that could easily or more easily be done on in straight AutoCAD."

The mechanical and plumbing contractor used 2-D drawings and said, "The schedule was such that we really didn't have time for BIM to begin with or for coordination. We skipped that step [of using 3-D modeling]."

- The use of building information modeling (BIM) was limited since the owner did not expect to use it in facilities management.
- BIM was used for prefabricated elements that needed coordination between multiple trades.

Context				Legal Commercial			Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes					
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- AKRON CHILDREN'S HOSPITAL, KAY JEWELERS PAVILION
- AUTODESK BUILDING INNOVATION LEARNING AND DESIGN SPACE
- MOSAIC CENTRE FOR CONSCIOUS COMMUNITY AND COMMERCE
- QUAIL RUN BEHAVIORAL HEALTH HOSPITAL
- ROCKY MOUNTAIN INSTITUTE INNOVATION CENTER
- ST. ANTHONY HOSPITAL
- SUTTER MEDICAL OFFICE BUILDINGS (LOS GATOS & SUNNYVALE)
- T. ROWE PRICE OWINGS MILLS CAMPUS BUILDING 1
- WEKIVA SPRINGS CENTER EXPANSION

Workplace

The relatively small size of the project made it difficult to truly co-locate. The team set up a Big Room off-site in the contractor's office that was large enough for the entire core team plus additional participants to convene, and they met approximately every two weeks. Later in the project, the owner invested in a "solid team Big Room" located on-site, with extensive visual documentation. Team members noted that the on-site Big Room was used more often than the off-site room for daily huddles, Plus/Delta meetings, and weekly Last Planner production meetings. Comparing the transition from the off-site to on-site Big Room, the architect said, "Fortunately, the general contractor had a local office, and we were able to use their resources. It was very well appointed, with electronics and appropriate space to do pull planning, to put notes up. It was convenient; it was very accommodating. In other words, it was an environment in which you didn't have to worry about the environment. You could get on with the task at hand. Later on in the project, we relocated to trailers on the site, and that, for obvious reasons, was very convenient. Especially if you had design issues, you could walk out to the project itself." The mechanical and plumbing contractor recalled, "We built a trailer on-site, rented trailers, and set them up specifically to have housed foremen all in the same place to be able to communicate more effectively together as one team. We had our meetings in there. It was set up with television screens, had everything we could need. It was very effective. Other things, like bringing in air-conditioned bathrooms for the field personnel workers, were also positive."

The team prioritized visually documenting the pull planning results, allowing team members to see what was coming up and where they were expected to be working. Other visual documentation was produced as well, the owner said, "In

terms of dashboarding, we made very good use of the Big Room walls, getting materials up there. Some of the simplest things were getting laminated sheets up on the wall to track profit pools and track Last Planner or PPC, things like that, to measure how the team was doing. It was really useful. Simple things like laminated building plans [were valuable] because we found that there is no substitute for team members being able to walk up, take a dry erase marker, and just start sketching ideas on top of a laminated plan."

On future projects, one of the things the owner would do differently would be to convene the Last Planner activities on-site and to mobilize them much earlier. While acknowledging the challenges of setting up a Big Room before the project start, they would try to have Last Planner sessions on-site four to five weeks before any work is started for a project of a similar size. They have found that there is great value to early planning to introduce learning and to set up processes before the team gets caught up in the daily needs of running the project: "We've tried [early set up] now on two projects and have seen the direct benefits of it. There's team-building time that they get out of that and the planning time that they get out of that—that's hugely beneficial to the project overall."

The contractor said that for the Big Room meetings "it was more like commuting than co-location" for the team members who kept their offices as their home base. The contractor also enjoyed seeing the visual management, which was both in the trailer and in the field: "We plan our schedules around blocking areas. Those areas were clearly labeled within the field, so that it wasn't just the office talking about individual areas as Area 2 or 2A or 2B, but if you were to walk out in the field, you would know very specifically when you crossed from Area 2A into 2B because of the signage that was there."

- The relatively small size of this project made it difficult to co-locate.
- Early in the project, the team used space in the contractor's office; later, the owner invested in a Big Room on-site.
- The owner believes an earlier Big Room set up with earlier Last Planner activities would have been beneficial.
- The team prioritized visual documentation to track profit pools, Last Planner updates, PPC, as well as laminated building plans for markup.
- Visual demarcation of site areas on plans matched clear signage on-site.

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Team Alignment

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“Our financial structure works reasonably well,” the owner stated, “in terms of taking the risk for project costs away from the team and putting it on the owner’s shoulders so that the team can be focused around really looking at value and driving toward outcomes with just the liability of their profit.” He also believes that for this project, it was effective to use the reward pool “as a scorecard, keeping that visible in the team Big Room and showing how the team was progressing toward profit.”

The contractor thought that the financial aspects of the contract had a “powerful, positive impact” for those companies included in the profit pool: “They felt closer to the client, and there was a general understanding of stewardship of the client’s needs that maybe doesn’t exist on other projects.” He characterized team discussions: “During the estimating process, in our Big Rooms, we would open up every detail...Everybody would post their updated estimates and details in the Big Room so that people could look at them. And then we would openly discuss and record any updates and changes. So that was very transparent...there were some ups and downs, due to scope changes, misunderstandings, or mistakes....The idea of having to open up your books and show them, and be ready to respond to questions made everybody feel very accountable to each other.”

The architect believed that the “tone” of the contract fostered collaboration without the adversarial issues that are typical in this kind of project. Moreover, he thought, “The way that shared-profit goals are structured, with the actions of one or more team members affecting everyone else’s end result, had a positive impact because it kept everyone on their toes. They were more aware of their actions influencing more than just their narrow scope of work.” The architect thought that the team’s interest in cost savings could be

too aggressive at times: “For example, they [the team] did not want us to spend time doing a lot of the specifications we typically would because they saw that as redundant. In their opinion, everyone knows what needs to happen in the building, but from a liability standpoint we were very reluctant to delete or not include this information in the documents. There was some back-and-forth banter on that, and we arrived at a happy medium, with us insisting on certain things and conceding that certain things of less concern could be omitted.” Another side of the story was told by the MEP engineer, who said, “One of the goals was to lessen or minimize specifications. That was a challenge that I don’t know that we really made any progress on.”

The MEP engineer saw that the most significant difference on an IPD project was “the openness, collaboration, and the willingness to abandon the thinking of protecting your own versus protecting the good of the project while not giving away your own securities financially.” For the MEP engineer, “It was eye-opening and refreshing way to do a construction project.” Some of the challenges that related to the contract, according to the MEP engineer, were some issues around how the team handled insurance, permitting, and warranty, but they felt they were all satisfactorily dealt with. The engineer viewed the following as the most positive effects of the contract: “The parameters of the deal regarding the Lean plan, the owner’s guaranty of your cost plus overhead was very attractive to us. It certainly guided our budgeting in terms of just constantly meeting or exceeding those goals to get everybody into their bonus profit.”

The owner said that fiscal transparency was a rule of engagement. “It’s been a learning curve and it’s something we got better at by the end of this project. The expectation

was that each team member would bring their actual costs to the table and review those with every other signer of the agreement. Real visibility into the bare costs is a requirement for playing in the environment.” The owner said that some team members struggled because, “We tried to bring not just cost reporting but also cost projecting and labor feedback, measuring productivity and projecting outcomes based on actual productivities, and not everybody has that.” He recalls coaching some partners but noted that it took time for them to understand the value of reporting in this way.

The mechanical and plumbing contractor said that the fiscal transparency on the project did not have an impact on their behaviors. “I would say not really because that’s generally how I deal anyway. We’re pretty open with our customers here. We will show anybody cost and be up front with them.”

- The owner believes sharing of “bare costs is a requirement for playing in this environment.”
- The contractor believed profit-pool participants took a stewardship role, advancing the owner’s goals.
- Collaboration fostered by open-book financial-information sharing “made everyone feel very accountable to each other.”
- The architect thought the tone of the contract “kept everyone on their toes” and, generally, very aware of the impact of their actions on others and the project as a whole.

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Collaboration

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WEKIVA SPRINGS CENTER EXPANSION

The owner said that the only real metric they started with was target cost: “We started the project already having allocated all the capital to it, so there wasn’t really an opportunity to develop that [target-cost number] within the team.” The team tracked financial goals and profit pools in addition to monthly checks of team-based and process-based goals. Measurement, according to the owner, was “nothing super scientific, just green, yellow, red, in terms of how we measured against each one.”

In the contractor’s mind, metrics were divided into qualitative (conditions of satisfaction) and quantitative (target cost and schedule dates). The contractor did not know of a metric to measure team effectiveness: “I think we might have evaluated relative to team health and relative to project success. I don’t know that we had an individual team-effectiveness evaluation.”

The architect thought that the success was measured on three main objectives: one was meeting the schedule, the second was budget, and third was the owner satisfaction with the end result. He believed the team’s process for managing the budget “was very well organized. It was almost a weekly or a daily update and review of that information.” He added, “I believe, in hindsight, that we could have done a better job of meeting the owner’s expectations in a few particular areas, but I think overall it was successful.”

The contractor reflected on the change in their own behavior: “When we first jumped in, we were so afraid to state our opinion over somebody else,” but later in the project the exchange among team members became very fluid and comfortable. The contractor thought that the team and owner were “very trusting of each other,” giving the example of how

they accepted that extensive auditing of man-hours was not feasible.

The owner thinks coaching and on-boarding ensured people knew they had freedom to trade scope or finances across contract-party boundaries. There were numerous examples of scope being traded between partners: the site contractor did extra digging for the MEP and underground utilities, instead of each trade trenching and backfilling; there was a collective pool of general scope items, like fire caulking, that are typically split between individual trades; a mechanical subcontractor who was part of the prefab effort collected some drywall framing, so they could preassemble shower stalls. Overall, the owner thought the team was “fairly successful... understanding that there are no boundaries....It’s everybody’s money, spend it in the most effective way possible.” The contractor said the team appreciated that scope swapping was not tracked. He explained, “If one guy was doing blocking and another guy wanted to jump in and take care of it for him, we didn’t go through any effort to exchange budgets. All we did was project cost. Once we got the supervisors to understand what that meant, there was some significant productivity improvements in terms of our fieldworkers being willing to trade and share workers. It really helped them level their resources, especially on the labor level, being able to share a guy for cleanup and then bring him back to do some rough carpentry for somebody, and move them around...It wasn’t, ‘If I’m going to go do this for you, you’re going to have to tell me how much money you had.’ Taking that discussion off the table was very beneficial.”

The team noted one trade partner as a positive contributor for their innovative thinking around prefabrication and their willingness to explore and experiment. However, according to

the owner, this level of exploration “caused a whole another challenge because they didn’t have a way of anticipating what the prefab would cost and what their expected benefit of prefab would be on productivity. For them it was really an experiment. They just took the initiative and said, ‘We’re going to gamble a little bit, and we’re just going to assume this is the right way to go.’ At the end of the prefab stage, they essentially had to say, ‘Here’s how much we spent on prefab, and we hope that this is enough benefit to our production that it’s a net benefit.’” The owner believed that, overall, there was a net benefit for the project financially, and they had the additional bonus of a unique video that highlighted the Lean process. “We had a time-lapse video of the prefab racks being installed in the air, in the ceiling. Watching the video, you can just tell the minimal amount of effort that the field crew had to exert to get that amount of work into the ceiling. It was pretty impressive watching it in time lapse versus what you normally see when mechanical guys go up and down ladders to hang duct work.”

- Coaching helped the team take advantage of the freedom to trade scope between partners.
- Scope trades were not carefully tracked; this helped make the trading easier and saved time.
- The contractor noted that the team shifted from hesitation about expressing opinions to fluid and robust discussions.
- Exploration of untried techniques in prefabrication created uncertainty about costs and feasibility.

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Team Culture

“We still hold up this project, in particular, as one of our real success stories, both from physical project outcomes and team outcomes,” stated the owner. “There were some rocky spots, but everybody generally agrees that this is one of our better implementations of the Lean IPD team and, also, [positive] outcomes in terms of behavioral goals that we had.”

The owner said, “Humor has got to be part of the project. We learned that on this one.” One instance of humor related to how the team kept time. The owner recalled, “We try to have a timekeeper on every project, but we weren’t good about enforcing it all the time. We tried to have a timekeeping device on every project so that—especially if the timekeeper is shy and doesn’t want to stand up and yell ‘time!’—it’s easy for them to make a noise. For this one, it ended up being a pink-suede squeaky-dog toy. The label of the toy was Squido, so that became our nickname for the timekeeper.” Another instance of humor related to nicknames. The owner said, “I don’t remember how he got the nickname Ham and Cheese, but that was our mechanical project manager. Somehow during the course of the project some story about ham and cheese came out and the nickname stuck, so you can’t lose him.”

The team was able to make decisions effectively. For example, the contractor thought the agenda format was especially valuable, since there could not be an agenda item without a specific objective tied to it. “We had really specific time slots that helped us manage, and ultimately, it really helped inform future meetings as to how much time we really spend on tasks. And if ahead of time, we didn’t think we should be spending that much time, making sure we did talk about the right things at the meetings.” He would have preferred that the daily huddles were more consistently productive: “The

daily huddles were definitely encouraged, and we had some hits and misses in terms of being executing that in the best way possible, but they were trying.”

- The owner believes that the project was “one of our better implementations” of Lean and IPD.
- The team used humor effectively and regularly, and the owner believes that was important.

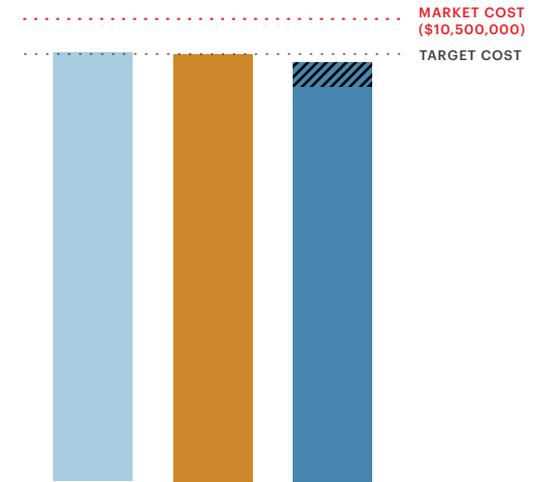
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Profit & Payout

The architect thought that the financial incentives tied to project goals were very clear. "They did a very good job of documenting and relaying that information in real time. Everyone had a sense of what was going on, and we could make informed decisions as far as how to move next if there was a particular problem or area of concern regarding the finances or schedule."

- The architect believed the financial incentives were very clear and found it helpful that progress was tracked in real time.

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WEKIVA SPRINGS PROJECT COSTS AND PROFIT

The final project cost of \$9.5M was approximately \$200,000 less than the target cost. The profit payout was approximately \$560,000, almost 6% of the final project cost. The target cost was set through a process comparing past projects and adjusting for local conditions and program. UHS does not use market comparison since their buildings are different than many on the market, but the team estimates the market cost on a similar project traditionally delivered would have been \$10.5M.

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Budget & Schedule

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The owner's project manager was involved approximately eight to twelve hours a week in the early part of the project since "we have the most impact right at the beginning, baking in the culture and coaching." During construction his time dropped dramatically to eight hours a month.

The contractor said that their experience on other IPD projects helped them budget time and advise trade partners, "so that they didn't come in and have an overhead percentage that was too low. That's been a lessons learned from other projects. And also making sure that the fee evaluation is based on that level of personnel involvement." For the contractor, a full-time project manager and 20% of the senior manager was "the right balance. It's probably a little bit more than what we would normally have on a project of that size if there's conventional delivery." He observed that additional time in preconstruction was substantial, but "that's obviously something that UHS elects to do because they see it as a cost shift. It's something that they'll spend a little more up front on to save money on the building."

The architect commented, IPD requires "a lot more meeting time versus actual production and design time. It was challenging at first to adapt to that, but once we understood the time commitment, it was easy for us to make those adjustments internally." The project manager for mechanical and plumbing partner spent twice as much time as a typical project early but less later on. He said, "You end up spending in a lot more time up front planning and getting the design right first, as opposed to on the back end figuring out as you go."

Lessons learned for the owner: define milestones differently and simplify Last Planner to be easier to manage. On the project, the team struggled to track how weekly work plan

progress was impacting milestones. The team attributed those challenges to the manner in which they define milestones: "We've tended, in the past, to define milestones around completion of major phases, like steel topped out or dried in. What we are shifting to or trying to do in this project is really dig into what is a meaningful definition of a milestone." The owner's representative added another observation about the need to create "urgency earlier around missing milestones. We tended to have a bit of false optimism, that when we were running behind, we would make it up down the road without having a clear action plan to getting back on track. One of the specific lessons coming from this project was that if that first milestone is slipping, let's immediately stop and do a recovery plan."

As the team succeeded in establishing cost savings, the owner was able to add a programmatic scope that was not in the original project plan. The owner thought frequently revising design to reduce costs "was effective because we were able to do that on smaller iteration cycles rather than getting to the end of the design and realizing we had issues. On the flip side of that, as we went through the design we were able to identify some value-add items that were more preferences than core needs. We couldn't afford them in that particular budget iteration, but we were able to manage those things and track them so that as we liberated savings from the project, we could buy those value-add items in." The contractor said, "The key to the concept in which we were trying to deliver was not draw, then value engineer and take off the drawings. It was to make sure what was getting on the drawings had already been vetted to be the most cost-effective way to give the client the benefits they wanted. The intention was to spend more time on the conceptual estimating side of it. The right information would be on the

drawings." The architect's opinion was that "the value ended up being there, but I think it delayed some of the design process. So from my standpoint, it was frustrating. But for the overall good of the project, it ended up being a benefit." The architect gave the example of coordinating drainage, windows, and doors with the EIFS system to illustrate the tension between decision priorities of designers and of the rest of the team: "From a design standpoint, much of that wants to be decided as early as possible because it affects all of the details. Especially here in Florida, where we are obligated to do things for impact and hurricane resistance, there is a lot of design associated for the whole wall, not just simply creating an opening. From the contractor and budget standpoint, they wanted to leave that decision until the end for many other reasons relevant to integrated project delivery. You want to get the best value, and you want to work at the last responsible moment."

- The owner was able to add programmatic scope, with budget savings generated by the team.
- More time spent early was a "cost shift," resulting in less spending later.
- The team struggled with the way milestones were defined, finding it challenging to track progress relative to milestones in the weekly work plans.
- The owner saw value in repeated small design iterations informed by costing.

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Building Outcomes

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The site was a challenge, as there were many environmental concerns, and the geometry of the site made it difficult to fit the expansion. The program went beyond simply an expansion, as there were backfill areas that were to move into the expansion, which had to be adapted for new use. The size of the expansions meant that the buildings had to be detached in order to meet the fire code.

The architect, in the interest of keeping the budget and schedule, sacrificed a part of the flexibility and usability of some of the nurse-station areas. "I believe, with that exception, the project was very successful. It's one of those hindsight realizations, that we could have done a better job in the nurse-station area."

The owner said that their goals for the project were met. "They evolved only a little in terms of some wish-list things, programmatically, that were added in, but in terms of just business-case goals—that stayed pretty true to what we originally set out to do. In terms of team goals, our hope when we were launching this was that we, as in UHS, could leverage the training we did with the team and take that to another project shortly thereafter. We haven't been able to do that, unfortunately. Other people are getting some of the benefit of that training. That was one of the team goals we couldn't establish, just because the next project stalled, and we couldn't get it fired up in time to make use of the team that was set up."

The contractor thought that the team met the owner's objectives. "It was interesting because when we got into the project, we set some pretty high goals. We were driving for those goals. At one point in the job, when we realized that maybe we weren't going to hit all of those goals—they called them 'targets' and not 'requirements'—there was

some frustration and disappointment. What it took was for us to go back and think about if this project had been done in the conventional manner, how long would it have taken and how much would it have cost? All of a sudden, you realize that even though we didn't hit all the target goal that we had hoped to do, we still beat the lights out of what we would have budgeted for a schedule and cost on a project like this that wasn't done with IPD. It took that to realize how successful the team was."

The architect said, "It's a very successful project, and I've heard as such from the owner and others involved. Personally, I feel it was successful because it was very challenging. We overcame a lot of potential pitfalls on the project, and given the dynamics of this project, it was very successful."

- The team resolved the many technical challenges of a difficult site.
- While the building goals were met, the architect reflected that the nurses' stations sacrificed some flexibility and usability in order to meet budget and schedule goals.

Context				Legal Commercial				Leadership & Management				Processes & Lean				Alignment & Goals			Building Outcomes				
At A Glance	Project Description	Project Timeline	Owner Identity & Interface	Choosing IPD & Lean	Team Selection	Developing Contract	Developing Parties	Champions	Decision Structure	On Board & Off Board	Clarity of Goals	Resources & Facilitation	Tools & Processes	Lean Effectiveness	BIM	Workplace	Team Alignment	Collaboration	Team Culture	Profit & Payout	Budget & Schedule	Building Outcomes	Project Credits

Project Credits

PROJECT TEAM

Signatory & Risk/Reward Pool

Universal Health Services (UHS), Owner

Brasfield & Gorrie, Contractor

Harvard Jolly, Architect

In Design Inc, Interior Design

W.W. Gay Mechanical Contractor, Engineer and Trade Partner

Bergelectric, Engineer and Trade Partner

McVeigh & Magnum, Trade Partner

W.W. Gay Mechanical Contractor, Trade Partner

Bergelectric, Trade Partner

Vallencourt Construction, Trade Partner

Wal-Mark Contracting Group, Trade Partner

INTERVIEWEES

Owner (UHS)

Christian Pikel (Regional Project Manager)

Contractor (Brasfield & Gorrie)

Fred Henderson (Senior Project Manager)

Architect (Harvard Jolly)

Howard Braukman (Architect)

Mechanical and Plumbing (W.W. Gay Mechanical Contractor)

John Fields (Project Manager)

AKRON CHILDREN'S HOSPITAL, KAY
JEWELERS PAVILION

AUTODESK BUILDING INNOVATION
LEARNING AND DESIGN SPACE

MOSAIC CENTRE FOR CONSCIOUS
COMMUNITY AND COMMERCE

QUAIL RUN BEHAVIORAL HEALTH
HOSPITAL

ROCKY MOUNTAIN INSTITUTE
INNOVATION CENTER

ST. ANTHONY HOSPITAL

SUTTER MEDICAL OFFICE BUILDINGS
(LOS GATOS & SUNNYVALE)

T. ROWE PRICE OWINGS MILLS
CAMPUS BUILDING 1

WEKIVA SPRINGS CENTER EXPANSION