Project Collaboration Best Practices

A Resource Guide to Enhance the Level of Collaboration on Projects, Regardless of Delivery Method

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The Purpose of this Guide:

Building upon the experience gained during the completion of past projects, the creators of this document intend for this Guide to contain practical and specific recommendations, best practices, and resources for all important phases of projects to assist Owners, Architects, Constructors, and all construction team members to enable higher levels of collaboration. Specific case studies are also presented that highlight the collaborative principles utilized, and the values recognized, on projects that have achieved high levels of collaboration.

Our hope is that this Guide will encourage and facilitate higher levels of collaboration on all project types, regardless of delivery method and size of project, which will result in truly collaborative and successful construction projects.

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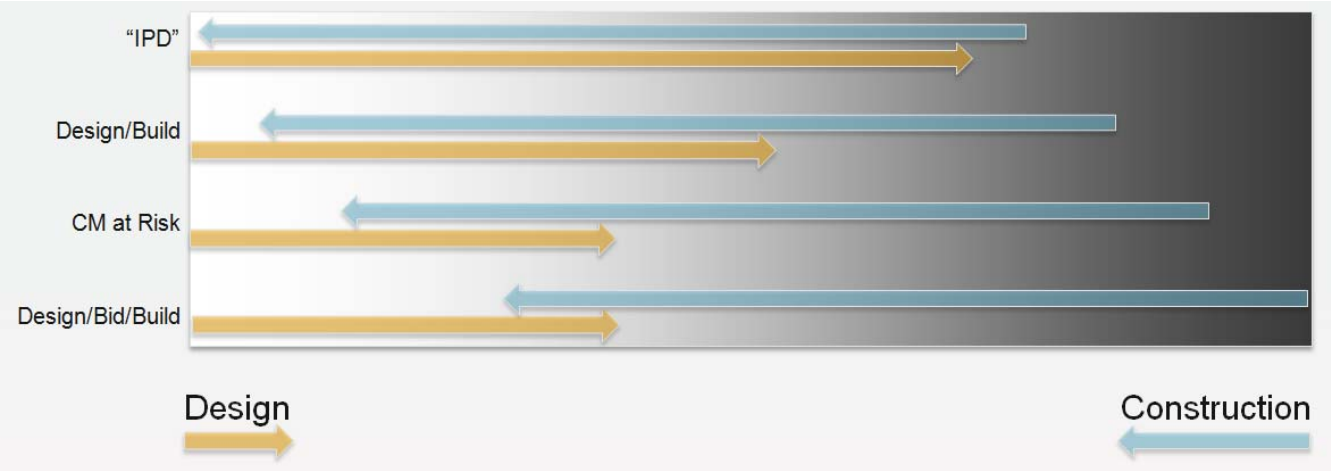
Chapter 1: Benefits of Collaboration

"Every now and then a major construction project is completed on time and on budget. Everyone is amazed."
Broken Building Busted Budgets by Barry B. Lepatner

Collaboration is defined by Merriam-Webster as "to work with another person or group in order to achieve or do something." Recognizing that building projects are highly complex and require the unique expertise from a vast variety of design, construction, and facility management professionals, it is logical to think that getting all project participants to work together more collaboratively would bring better results. Data and feedback from completed collaborative projects bears this out.

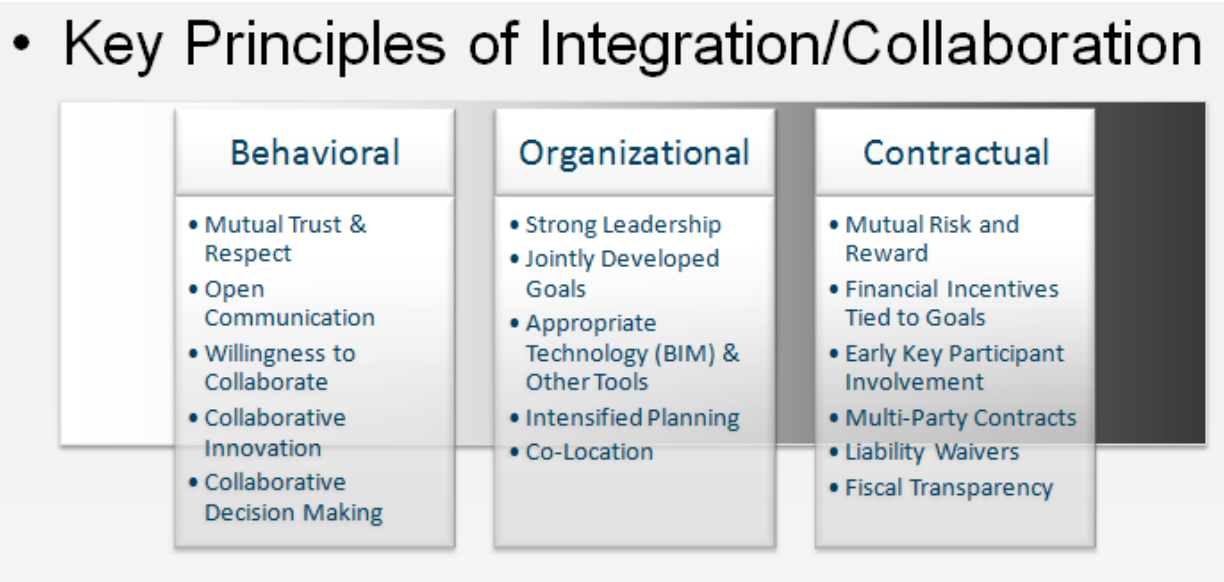
A 1997 Penn State Study of 351 completed projects quantified that cost and schedule increases were lower and quality was higher in design-build projects, which allows for higher levels of collaboration. A study of 408 projects by Cannistraro quantified a decrease in change orders (the main source of budget and schedule overruns) from 18.42% to 2.68% by teams collaborating using Building Information Modeling (BIM). Collaborative processes are also now being recommended and recognized in sustainable design rating systems, such as LEED, as well as energy codes with ASHRAE's Standard 189, as a process that greatly improves sustainable results.

Despite the evident value provided by higher levels of collaboration, our industry continues to prescribe project delivery systems that do not encourage collaboration for the perceived value of the competitive bid. The chart below illustrates how various delivery systems may enable higher levels of collaboration by overlapping design and construction; providing better opportunities to work together as a team:



We understand that the Design-Bid-Build delivery model may be mandated for some project types. We also realize that this traditional delivery system has caused adversarial, non-collaborative behaviors to be engrained into our culture. As a result, these engrained behaviors are known to present themselves even when other, more collaborative, delivery systems are implemented.

Therefore, while certain delivery systems may *potentially* support higher levels of collaboration through contractual prescription, this guide focuses more on the behavioral and organizational collaborative principles and best practices that may be implemented through all delivery systems.



Chapter 2: Establishing the Culture of Collaboration

"Owners cannot change building professional's education, but they can provide leadership in changing the dynamics of information sharing and innovation."
The Owner's Dilemma by Barbara White Bryson

Collaboration is transforming the construction industry. The practice of establishing a culture of teamwork and collaboration can be one of the most challenging, but most important, aspects of a project. The expectation of collaboration must be stated clearly by the Owner early on in the project development, even prior to project team selection. It is critical that the Owner selection committee establish this as one of the primary drivers of the selection process, setting the foundation for a truly collaborative project.

On the majority of projects, it is the intent of a project team to have a truly collaborative and successful project. This may or may not happen and is dependent on various factors: experience of the team, personalities of individuals, processes established, technology applied, project delivery method, agreement and contract language, and Owner expectations. Unfortunately, we are reminded much too often of the finger pointing, adversarial relationships, personality conflicts, and lack of respect and trust that exist on many projects. An Owner must consider these actions unacceptable and establish a commitment by the team to focus on a positive and productive environment.

Regardless of the delivery method, the Owner stated expectation of teamwork as a core value can have a positive impact on the project. It is our recommendation that the following core collaboration principles be established by the Owner's leadership on any project: ***respect, trust, transparency, reliable promising, and continuous improvement.*** This will create a more positive and innovative project environment that will influence the behavior of the team. This culture will ensure that a project team provides the best solution for a given problem, maximizing the value of the end product. As we explore how the Owner can establish this preferred behavior, there are four key areas to creating this culture on a project: internal, project team, project organization/framework, and recognition.

***Internal*:** To create a more collaborative project environment, we believe that education and development of internal project leadership can greatly enhance the effort. A current trend in the industry is a move towards Integrated Project Managers (IPM), who would have the skills to encourage and empower teams to more successfully execute projects. They would also have the ability to continuously drive innovation and track team performance. More on this concept can be found through the Lean Construction Institute offerings.

***Project Team*:** For projects with a more integrated approach, a core selection criteria of the project team must include an evaluation of the proposed individuals experience and expertise. An evaluation of the teamwork skills of the proposed individuals should be a focus during the selection process, along with evaluating the integrative culture of their respective firms. The

very root of successful collaboration is in the make-up of the project team. Changes must be made to the team if the behavior begins to move towards a more traditional approach.

***Project Organization/Framework*:** The Owner must establish a project framework to nurture teamwork, promote Lean principles, and monitor performance from the executive team to the trades in the field. A step-by-step process for optimizing team collaboration with enhanced results on a project is shared in Chapter 4. This team development process, led by a designated Project Coach, has been used on numerous successful projects. Through surveys of participants and process analysis, many feel this facilitated collaboration has had a positive impact on the projects. The concept and duties of a dedicated Project Coach will be explored.

Recognition: Continuous reward and praise of the application of collaborative principles by the project team must be recognized formally or informally throughout the project. This will solidify the learned behavior and promote this preferred culture on a project.

The commitment and expectation to discover the benefits of enhanced collaboration can be a primary driver of success on design and construction projects. The establishment of the culture of collaboration on a project should be an early requirement and, once achieved, project execution will become easier.

Chapter 3: Project Team Selection

"The low bidder is the one wondering what they left on the table."
The Commercial Real Estate Revolution by Rex Miller

Setting Up The Project For Success: A Good Foundation

Procurement of construction services is complex and true success is often elusive. The key to meeting the program goals and vision on any project is successfully choosing the right team as early as possible. It is easy for an Owner to say a project is going to adopt a collaborative process, but the Owner and its team must be willing to change from traditional, silo style processes. When choosing a more collaborative approach, the team should include the Owner, the Architect, the Constructor, as well as other design professionals and consultants, from the onset of the project. On a more complex project, this may even include early involvement of Subcontractors and material suppliers.

For a construction project, there are many types and sizes of design and construction firms to consider. Each firm brings its own expertise, skills, and values to the table. Finding the proper team, whose values align with the Owner and whose skills match the project needs, is not an easy task. Therefore, it is extremely critical to make good decisions, regarding team selection.

Even if the corporate values of the selected firms' align with the Owner, it is just as important to identify the individual professionals that will be assigned to the project. These individuals must have the support of upper management. If the support of upper management is not in place, then there will be a greater possibility of everyone simply falling back into their old and familiar patterns when the first major issue arises during the project. The team must have good chemistry, be willing and open to suggestions, and embrace an integrated approach. True collaboration places the project goals above those of the individual team members and is achieved only by including everyone, on everything, from day one.

The Selection Process: Weeding Through The Options

Choosing between the many qualified firms can be incredibly difficult; especially for the novice construction project Owner. Depending on the specific project, an Owner may contemplate the decision of bringing on the Architect first, the Constructor first, or bringing on both at the same time. Depending on the needs of your specific project, any of the three options could make sense. Since it is critical that the team members have mutually agreeable personalities, in some instances Owners have benefitted by having the Architect or Constructor on board first and having them assist with the selection of the other firm, as well as other complimentary firms.

Good referrals, recommendations, and a fabulous portfolio are great, but they cannot guarantee that there be team chemistry. When seeking firms, you may want to ask business associates or other Owners whom have constructed a similar project for recommendations. If an Owner does not feel comfortable consulting another Owner, they should try contacting a trade organization, such as the Master Builders' Association (MBA) or American Institute of Architects (AIA), for recommendations. Each of these organizations have referral lists, which can be a great place to start.

Starting with a broad list of Architects and Constructors to be considered for a construction project, gather as much information as possible on each firm. Next, request more specific information from a short list of approximately five (5) firms from each category. Utilize a formalized Request for Proposal (RFP) process, which implies that you are searching for a solution to solve a problem. The RFP should include, but not be limited to, items such as:

- Project Philosophy
- Similar Project Resume
- Proposed Team Structure and Resumes
- References
- Pre-Construction Fee
- Proposed Management Fee
- Itemized General Conditions
- Staff Hourly Rates

Along with the list of items above, an Owner may want to have firms address additional requirements, such as the following:

- Unique or innovative project approaches
- Disadvantaged business enterprise procurement strategies
- Quality control strategies
- Bond premium
- Sample insurance certificate
- Safety program overview

The RFP should clearly lay out how the Owner will proceed toward making a final decision. Information should include, but not limited to, items such as:

- How many firms will be interviewed
- Names and titles of the selection team
- Whom the selection team will include
- What the selection criteria includes
- How many firms will be further short-listed for formal interview

It is typical for the Owner to select approximately three (3) firms from the short-list to be invited for a personal interview. The formal interview should be a chance for all parties to get a more personal feel for how people solve problems and work collaboratively with the team. After formal interviews, each short-listed firm should have a clear understanding of how and when a decision will be made by the Owner.

Choosing the Right Team Matters

Every project is uniquely different, with its own set of goals, schedules, budgets, and challenges. When encountering challenges, the Owner will learn firsthand if they have the right team in place. The right team will encounter problems together and come up with solutions together. Choosing the right team members with whom to build with can be one of the most critical tasks on any project. Choose poorly and the project will likely be fraught with issues. Choose wisely and the team can help minimize risk while maximizing value to the Owner throughout the project.

Chapter 4: Optimizing the Collaborative Team

"Whether you're on a sports team, in an office or a member of a family, if you can't trust one another there's going to trouble."
The Speed of Trust by Stephen Covey

A collaborative team encourages early involvement of key project participants to define goals and build consensus. Working together, team members become problem solving innovators who, regardless of their role, are committed to the mission of the project in every respect.

A project's success should never be left to chance. A Project Coach can help make a project a success. Hired as an Owner's consultant, a Project Coach will work with the team to align individual goals and actions with the project mission through collaboration and information sharing. The Project Coach will guide the team to create a project environment that promotes transparency and produces accountability for the project mission, keeping the team motivated and focused on collaboration. While the concept of hiring a Project Coach is new to the construction industry, this position has had success in other industries.

When selecting a Project Coach, Owners should consider industry specific experience. In construction, this individual should be versed in both the design and construction side of the process. Effective motivation is a result of this individual's ability to listen to what is being said and turn it into positive messages; this is an essential skill. Project Coaches should be multifaceted with the ability to teach or work hand-in-hand with the team to resolve an issue. All coaches must have the capacity to follow the project from start to finish; continuity plays a role in success. Listening skills are a key competency to an effective Project Coach.

Team Development Process
Step 1: Develop Project Mission.
Goal: To be completely transparent on what defines success for the Project.
Success factors become the project mission for all team members. The Owner ultimately defines success. Each key stakeholder should identify how their organization defines success. A team's success is dependent on the individual contributions being aligned with a common mission.

Step 2: Define Team Purpose Statement.
Goal: To create a project specific purpose statement.
A team Purpose Statement illustrates how the team will succeed. Stating what the team will achieve together the Purpose Statement provides a focal point for performance.

Step 3: Create Performance Measures.
Goal: To set *project specific* performance measures that align with the success factors identified. Every project has the goal of being executed within budget and on-time. During team development sessions, we break down those mandatory goals into bite-size objectives, as well as establish other specific goals. Appreciative inquiry is used to develop team goals and strengths. It is important that each stakeholder have input on project goals and not rush this

process as it may take a few sessions. It is the responsibility of the Project Coach to structure the meetings to generate the best ideas.

Step 4: Develop Action Plans.
Goal: To create clear plans to achieve the success of each performance measure.
Goals are dreams unless you develop a plan to achieve them. Action plans identify the strategies, key initiatives, and measures for each goal, as well as identify who is primarily responsible for implementation.

Step 5: Gain Commitment and Align Roles with Team Purpose.
Goal: Affirming commitment to the Project Plan.
As new team members join the project, it is critical to create a new team member orientation process, which includes the Project Plan (mission, purpose, performance measures, and action plans). The teams create ways to incorporate goals into everyday activity including, but not limited to, daily huddles, posters, newsletters, and logos.

Step 6: Remain Focused.
Goal: Keep the team motivated and aligned with the project plan.
Success relies on executing a plan. Team Development sessions give the team the opportunity to step back and assess progress and alignment with the Plan. Each meeting must be interactive and never exceed 1 ½ hours in length. Team meetings should be scheduled at regular intervals during construction. Agenda topics should be customized to complement the current project activities. Most meetings start with an antidote about teamwork. Attendance at team meetings is required so that team members are current with their project team's performance and contribution to the project.

Step 7: Celebrate Success.
Goal: Personalized recognition provides the best motivation for continued commitment.
While the process is specifically structured, the path to creating a collaborative and committed team is unique to each project. The Project Coach should facilitate Team Development sessions to uniquely design them to keep defined success factors at the forefront. Starting at project initiation and continuing through construction, these sessions are designed to foster and strengthen the trust essential to successful teamwork. Trust is built when agreements about performance are made at the outset and discussed throughout the process. Sessions focus on elevating the cooperation necessary to solve inevitable challenges and maintain the desired level of performance. These are not technical problem-solving job meetings, but rather strategic discussions for aligning the team resources towards the project mission.

Maintaining focus on goals, while encouraging the opportunity to improve collaboration through Team Development sessions, increases the chances of a successful project. Team Development has proven to maximize the project outcomes, producing a cost-effective project that embodies the Project Mission and adds value to the project.

Chapter 5: Enhancing Collaboration through Technology

"To tap into the true power of this next generation of solutions, companies need to collaborate across a broader business and IT ecosystems: business units, alliance partners, the IT function, system and service integrators, vendors, outsourcers and more."
The Journal of High–Performance Business: A New Era of Collaboration by Marty Cole

Technology in construction has led to the improvement of safety, quality control, and communication, to name a few keys areas. This improvement has resulted in the elimination (or decrease) in fragmentation, duplication, and distrust. Operating an efficient construction project can be greatly assisted by the evolving technologies. However, there is an inherent interrelationship between technology and collaboration, as technology enables us to be more collaborative and, at the same time, requires us to be more collaborative in order to get the most value from technology. Additionally, the tools used must operate efficiently and in conjunction with standard operating procedures that already exist. Technology should add value to all parties involved without overcomplicating.

Technology Planning
A Technology Implementation Plan is a recommended approach to get all team members to understand the vision and objectives of the technology to be utilized on a project. To create this plan, it is suggested to begin with the end in mind – what deliverables does the Owner expect from the project? For example, does the Owner have expectations of monitoring energy efficiency based off of an as-built model for lifecycle maintenance? Once the expectations from the Owner are identified, the team can work collaboratively towards creating an appropriate Technology Implementation Plan. Having a comprehensive plan from the start of a project will be less expensive, and less frustrating, than trying to change on-the-fly during a project. By planning ahead, an Owner can achieve a good return on their investment.

The Tools
Encountering new technologies in construction has become part of the business. It seems as though new software programs, or processes, are entering the market all of the time. However, new technologies do not guarantee improved productivity, especially if the new tools are not coupled with good management practices. Each of the various tools has a different area of focus. As such, each tool requires a learning process to ensure that the user(s) and team members that are affected by the tool have an education on its associated processes. By allowing for the implementation of the learning process, the project team will improve their odds of gaining the maximum benefits from the implementation of each new technology.

Current advancements in construction technologies include:

1. Modeling – an enhanced electronic representation of a facility for the purpose of design, analysis, construction, operations, and facility management. As a project proceeds through its lifecycle, team members will use the model for different purposes allowing each team member to enhance collaboration throughout. During preconstruction and

construction, the model can serve as a verifiable step to illustrate design intent. Before delving into this technology, many organizations will refer to a BIM Execution Plan to ensure all parties are clearly aware of opportunities and responsibilities associated with the incorporation of BIM into a project workflow. To see an example visit: Penn State BIM Project Execution Planning Guide.

2. Project Management Information System (PMIS) – web-based software that provides a single source of up-to-date project information, including the list of project participants, contact information, bidders lists, contracts, payment applications, and other administrative project documents. In addition, it also allows for a collaborative, secure, online process for exchanging, reviewing, and archiving construction submittals, Requests For Information (RFIs), and other design and construction communications. Being that the software resides online, the contents are available from anywhere, at any time, with the proper hardware and internet connection.
3. Construction Documentation – the electronic plan tables where documents are shared to help the construction team reach the most up-to-date drawings, details, specifications, and trade packages at any time. At the end of the project, the Owner benefits from a more accurate documentation, as long as the team continues to collectively work together to keep the documents up-to-date and correct.
4. Web Conferencing Software – a combination of screen sharing and conferencing software that allows team members to meet, collaborate, and work together on aspects of a project in a virtual environment, without the need to leave their physical location.
5. Miscellaneous – additional topics that should be considered as technologies to be utilized on a project for the benefit of the collaborative team.
    a. Mobile technology (tablets, smartphones, etc.)
    b. Cloud vs. In-house servers
    c. Internet speeds on-site
    d. Wi-Fi on-site
    e. Computerized Maintenance Management System (CMMS)
    f. Laser Scanning
    g. CNC Machining
    h. Robotic Layout
    i. GPS-Linked Progress Photographs
    j. Online Bidding

Post Script:

For the technology section, names of products are not listed. We omitted them on purpose, opting to focus on the topic for which the tool is utilized. Since construction technology is advancing at an accelerated speed, with many tools currently in existence and many more in research and development, we felt that by naming products we would run the risk of leaving out some valuable tools. It is the intention of the AIA-MBA Joint Committee, through its Owner Roundtable Series, to host an annual session on technology to provide live demonstrations of current tools in action.

Chapter 6: Integrated Design Strategies

"It's as simple as this. When people don't unload their opinions and feel like they've been listened to, they won't really get on board."
The 5 Dysfunctions of a Team by Patrick Lencioni.

The American Institute of Architects defines Integrated Design as an "approach that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to Owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction." This approach to building design requires a multi-disciplinary and collaborative team whose members make decisions based upon a shared vision. This differs drastically from the previous design and construction approaches in the industry, which tended to operate in fragmented silos. As the construction industry is experiencing significant changes in the relationships between their respective professionals across the various delivery systems, Integrated Design is helping Owners to realize successful projects.

Pre Design – The Pre Design phase defines the project and its goals, sets the tone for the project, and helps the team to remain unified. The differences in priorities using an Integrated Design process, instead of a conventional design process, are evident right from the start, when a team establishes goals, core objectives, and direction of the project through a visioning process. This Pre Design process analyzes the project, its surroundings, and its intended use to reveal the optimum choices for the site, the occupants, and the Owner. Project targets should anticipate a full range of economic, environmental, and social performance criteria. The ambitious beginning requires input from the Owner to understand the intended use of the building, as well as requires many experts to be members of the design team from the outset.

To best leverage the skills of the diverse, knowledgeable team, the fee structure should be designed to provide appropriate incentives to the team. An Integrated Design facilitator should be appointed to establish a schedule and oversee key meetings; such meetings include:

- Charrette preparation
- Charrette workshop
- Programming meetings
- Facilities management meetings
- Partnership meetings

Under the direction of the facilitator, the Integrated Design process will produce a vision statement, goals and targets matrix, as well as establish communication protocols.

Schematic Design – The Schematic Design process builds upon the vision that was created in the previous step. In this step, the team explores innovative technologies, multiple ideas, and fresh application methods while working to achieve the goals and objectives established early on. The Schematic Design step allows experts from all disciplines to analyze the unique

opportunities and constraints of the building. It is important to keep the scope of the investigation broad, while simultaneously strengthening and adding depths to established goals and objectives. Schematic Design outputs include:

- Updated goals and targets matrix
- Preliminary financial estimate
- Schematic design report
- Roles and responsibilities matrix.

Design Development – The Design Development phase advances and validates choices recommended by the team and approved by the Owner in the Schematic Design process. All architectural, mechanical, and electrical systems are analyzed for expected performance. In addition, they are assessed for their impact on all of the other systems of the building, as well as their impact on the goals and targets of the project. This step yields the Design Development report, which summarizes the design and planning process to date. This report includes a summary of the building design and features, which incorporates the Owner and occupants requests and requirements. It also includes floor plans showing rooms, doors, walls, floor and ceiling finishes, system integration (mechanical, electrical, technology, etc.), and building envelope details. Finally, this report offers an opportunity for the team to express feedback prior to beginning working drawings.

Construction Documentation – The Construction Documents phase builds on the Design Development Report, and provides the project with technical documents required to construct the project, including all final calculations and specifications. As this phase increases the layers of design complexity and coordination, it is critical for the Integrated Design strategy to be maintained. The team facilitator role provides a unique perspective that allows them to be the champion of the process and see this final step in the design process through successfully. Key facilitator activities include:

- Keeping lines of communication open
- Coordinating documents between disciplines
- Hosting regular meetings to ensure the impacts of any changes are properly evaluated

Cardinal Wuerl North Catholic High School

PROJECT DESCRIPTION: A 185,000 SF private high school built in Cranberry Twp, PA. This ground up structure is a steel structure, brick and metal panel façade with windows. The total building cost was $50 M and it was delivered with a Hybrid Integrated Project Delivery System with a Lump Sum Contract.

MAJOR IMPETUS FOR HIGHER LEVELS OF COLLABORATION: Cost Control * Better Coordination * BIM * Value Engineering * Team Building * Claim Avoidance * Maximum Safety

KEY PLAYERS: OWNER: Diocese of Pittsburgh; ARCHITECT: Astorino; GENERAL CONTRACTOR: Mascaro Construction; MAJOR SUBCONTRACTORS: Cost Company, Lighthouse Electric and Renick Brothers.

PROJECT TEAM SELECTION CRITERION: BIM Experience & Cooperative with other firms

CULTURE AMONGST TEAM: Cooperative * Soulful * Flexible * Team Oriented

EARLY INVOLVEMENT OF PROJECT TEAM MEMBERS: A major reason why this project was successful was due to Mascaro's early involvement with BIM, Value Engineering, Schedule Solutions, and Logistics.

TECHNIQUES THAT ALLOWED TEAM TO OPERATE COLLABORATIVELY: Prayer * Unique Team Building Exercises * "Rocks in the Road" Analysis (A Mascaro Construction pre-construction team building activity to address potential project issues) * Demand for Respect at All Levels & at All Times

RESOURCES THAT ENHANCED COLLABORATION: BIM * Navisworks * Newforma Project Management

QUANTIFIABLE PROJECT OUTCOMES: No Lost Time due to Accidents * Met Budget * Met Schedule * LEED Silver Certification * Six Student Workshops

LESSSONS LEARNED FROM THIS PROJECT: We would have benefitted from a more coordinated set of documents.

THOUGHTS FROM THE OWNER:

"Collaboration requires solid leadership and the assembly of the right team members. Choosing the right team is essential."
Michael Arnold, Catholic Diocese of Pittsburgh

Cleveland Clinic Lutheran Hospital Emergency Department Expansion & Renovation

PROJECT DESCRIPTION: A 29,000 SF renovation and expansion of a hospital emergency department in Cleveland, OH. The building that the ED occupies was built in 1957. The new emergency department will increase by 30% to 21 beds and 30,000 patients a year. With a primary focus on behavioral health patients, safety of patients, and giving care are first priority. Construction is scheduled for 22 months and eight (8) phases. The total building cost is $12,900,000 and the project was delivered under an Owner Controlled Team Project Delivery (OCTPD).

MAJOR IMPETUS FOR HIGHER LEVELS OF COLLABORATION: With the rising cost of healthcare and the increase in demand for patient services, the Emergency Department needed to be upgraded to continue operation. Two previously completed projects had cost overruns of 46% on average and schedule delays. The Hospital could not accept this level of risk on this size project.

KEY PLAYERS: OWNER: Cleveland Clinic; ARCHITECT: Bostwick Design Partnership; CONSTRUCTION MANAGER: The Krill Company

PROJECT TEAM SELECTION CRITERION: The Architect was selected on a proposal basis. The Owner and Architect selected the Construction Manager early in Schematic Design. Selection was based on a request for proposal and the interview. Together, the Owner, Architect, and CM selected Design-Assist trades during Design Development. Design-Assist trades included: electrical engineering, mechanical engineering, interiors, and fire protection. All Design-Assist trades were required to bid the job. The fire protection Design-Assist trade did not complete construction.

CULTURE AMONGST TEAM: The culture among the team is one of respect. Respect for each other and the Hospital grounds they are working within. The CM and Subcontractors have direct relationships with the Architect. Throughout the course of the project, surveys were completed to gauge the level of teamwork. Surveys included questions related to trust, respect, and cooperation. The team consistently scored 4.5 out of 5, with 5 being the highest.

EARLY INVOLVEMENT OF PROJECT TEAM MEMBERS: This project team experienced an unprecedented level of commitment and engagement. The Owner and Architect selected the CM during Schematic Design. Design-Assist trades were selected early in Design Development. This engagement reduced the Owner's risk to typical project budget and schedule creep. On this project, the budget set at Schematic Design is holding through construction. The entire team is actively engaged during both design and construction, increasing their understanding of the project. Throughout the course of the project, the team has improved their productivity, ultimately resulting in net savings to the job.

TECHNIQUES THAT ALLOWED TEAM TO OPERATE COLLABORATELY:

- OCTPD is an Owner led delivery method. The Owner was a key stakeholder representative at all design and construction meetings. The facilities department coordinated with the design and construction teams with regards to the existing facility.
- A Project Coach was hired to facilitate a Team Development process. This process allowed the team to create a common mission and project specific goals. The team created unique action plans to achieve project goals. Together they monitored progress and remained focused on the aforementioned project-specific goals during construction.
- Multi-discipline task teams were deployed to track progress on goals and solve specific problems as necessary. This task team approach created the opportunity for the appropriate team member to be involved in the solution. Additionally, it added to the complete transparency of the project status by all entities involved in the project team.

RESOURCES THAT ENHANCED COLLABORATION:

- BIM was used as a communication tool. Models and details were shared during design. Existing conditions were modeled and the BIM model was used to proactively work through field conditions, identify conflicts, and share knowledge.
- Old-fashioned, standard conversations were used. Every key team member had headquarters within ten miles of the job site. The team capitalized on this proximity during design and construction as face-to-face meetings were held with little advanced noticed, often to get to an immediate solution or to keep team members informed of progress.

QUANTIFIABLE PROJECT OUTCOMES:

- The project budget established at the conclusion of Schematic Design has held through 70% completion of construction. The team does not see that this will change.
- 96% of the construction contingency remains unused.
- Changes during construction have resulted in a savings (give back) to the project budget.
- Rework due to unforeseen conditions has been less than $5,000. This is unprecedented for renovating a 1957 building.
- Patient satisfaction scores have increased during construction.
- There have been no recordable safety infractions through 70% construction completion.

LESSONS LEARNED FROM THIS PROJECT: The project had four major goals: maintain patient/staff/team satisfaction, manage the budget and schedule, keep leadership engaged and informed, and make decisions with the entire hospital in mind. The key lessons learned for each are as follows:

- **Maintain Patient/Staff/Team Satisfaction:** When working within an existing hospital, it is critical to keep the patients and staff informed on the impact of the construction project. To do this, we notified staff verbally during their hospital daily safety huddles, and we sent out weekly newsletters highlighting the upcoming work and noise level. These two things allowed the caregivers to not be surprised by the level of activity. The team made an improvement by allowing for more time for staff to move into space before opening. We made an adjustment to the schedule Phases 2-5 after Phase 1 opening resulted in frustrated staff.
- **Manage Budget and Schedule:** The key to this was two-fold: full transparency and compartmentalizing budget and schedule into small manageable parts. Our team focused on eliminating rework from unknown conditions and Owner changes. To manage unforeseen conditions, the Architect partnered with Design-Assist trades to complete an invasive existing conditions review. This investigation during design, coupled with using BIM, allowed the team to effectively manage existing conditions. One lesson learned was to model all existing conditions. The team made a decision to not include an area in the model during design, this area proved to be the most difficult to build. Building a visually effective design model which accurately represented the clinical spaces allowed the Owner to understand their new working conditions. Reviewing 3D design with the clinical team, once again, just before construction, proved to be beneficial to both budget and schedule.
- **Keep Leadership Engaged and Informed:** The construction team developed a customized monthly reporting system that detailed the budget and schedule, highlighting specific goals; such as: contingency spent, rework, changes, and RFIs. This consistent and transparent report allowed leadership to make informed project decisions. The leadership team from all project partners were are engaged in regular jobsite rounding sessions as a result. These sessions mirrored clinical rounds by physicians and allowed the team to gauge the status of the project. Rounding occurred every two weeks during the twenty-two month project.
- **"Make Decisions With The Entire Building In Mind":** The construction team was able to coordinate critical shutdowns and temporary heating/cooling without impacting patient care. Additionally, the construction team was able to stop and rework their schedule without impact to the project schedule or budget when exterior work impacted and caused vibration of the operating room.

Penn State University Henderson Project Phase 2: Health & Human Development Building

PROJECT DESCRIPTION: The Health & Human Development Building is the second phase of a two-phase, Pennsylvania Department of General Services-funded project for the College of Health & Human Development. This project consisted of 105,505 SF of new construction and 39,147 SF of renovation construction and the total building cost is $43,500,000 for this project on Penn State University Main Campus. This project is delivered as a Design-Bid-Build multiple prime delivery method.

MAJOR IMPETUS FOR HIGHER LEVELS OF COLLABORATION: Penn State's Office of Physical Plant selected this project as one of several pilot projects to test process innovations in an effort to create higher-performing and more predictable construction delivery outcomes. The two-phase Henderson project also presented a unique opportunity to explore the benefits of facilitated collaboration, as many members of both the design and construction teams continued on from the initial phase, which was delivered in the traditional manner.

KEY PLAYERS: OWNER: The Pennsylvania State University; ARCHITECT: Bohlin-Cywinski Jackson; CONSTRUCTION MANAGER (Agency CM): Massaro Corporation

PROJECT TEAM SELECTION CRITERION: The Architect and Construction Manager were pre-selected. Design-Assist from trade contractors was limited due to contractual limitations by the funding source (DGS). Under these limitations it was not permissible to directly engage trade contractors in advance of the open public bid process. Massaro engaged three non-bidding, Design-Assist trade contractors for limited scope.

CULTURE AMONGST TEAM: The team was generally engaged and positive, with communications being typically quite candid. Everyone constantly communicated face-to-face. Regular 360 Team Surveys indicate high marks for respect, teamwork, cooperation and other leading indicators of high-performance.

EARLY INVOLVEMENT OF PROJECT TEAM MEMBERS: Penn State, the Architect and CM participated in a number of Design Development workshops centered on collaboration and process improvement. After establishing a common project purpose statement and achieving consensus on key performance indicators, the focus turned to basic job processes. The goal was to improve results in a direct and measurable way over the Phase 1 project. Key innovations were made in managing safety, cost control, issues, RFIs, and submittals.

TECHNIQUES THAT ALLOWED TEAM TO OPERATE COLLABORATELY:

- BIM coordination during design and construction – essential for building common understanding, identifying and resolving conflicts, and reducing rework.
- Sharing space in the "Big Room" – broke down typical barriers to engagement and communication.
- Collaborative pull planning from the field – empowered the trades to "own" the schedule as a team.
- Mobile Project Management Information Systems – facilitating improved monitoring, as well as streamlining issue tracking and resolution.
- Personal commitment to collaborate and excel – with strong leadership from Penn State and expressed in tens of thousands of individuals and group interactions over the course of the project.
- Design team had a constant jobsite presence.

RESOURCES THAT ENHANCED COLLABORATION:

- Prolog by Meridian Systems for Project Management Information System including Cost Control.
- Revit/Navisworks/360/Glue by Autodesk for BIM development and coordination.
- BIM 360 Field by Autodesk for mobile field data and document management.
- Revu by Bluebeam for processing electronic documents and submittals.
- The "Big Room" established on site as all parties were required to collocate in this shared working environment.
- Pull Planning to work with whiteboards to develop and make visible the schedule.

QUANTIFIABLE PROJECT OUTCOMES: Due to the project ending recently, data collection and evaluation is still ongoing at this time.

LESSONS LEARNED FROM THIS PROJECT:

- Process Improvement Model (PIM): Face-to-face interaction and focus on information quality.
- Big Room: Overall configuration works well, central collaboration space is heavily used, placing assigned CM staff adjacent to their Primes boosted personal engagement and communication.
- Pull planning: The value of this approach on schedule delivery has exceeded everyone's expectations.

Penn State University South Halls

PROJECT DESCRIPTION: This 365,000 SF, $88 million Design-Build construction project was a transformative phased renovation of eight 1950's residence halls at the southern edge of campus, facing downtown State College. The project also includes significant improvements to the district dining commons and the construction of one new residence hall.

MAJOR IMPETUS FOR HIGHER LEVELS OF COLLABORATION: Delivering a more collaborative project is now a Penn State contract requirement and the selection of Design-Build delivery method allowed for higher levels. Prior Barton Malow and Clark Nexsen joint experience and the long length of project, overlapping phases, and aggressive dates for individual residence hall completion requires a high performance team and early Design-Assist Subcontractor involvement.

KEY PLAYERS: OWNER: Penn State University; ARCHITECT: Clark Nexsen; GENERAL CONTRACTOR: Barton Malow.

PROJECT TEAM SELECTION CRITERION: The selection of Design-Build as the delivery system placed an emphasis on the relationship between the Constructor and the Architect, and the team's ability to work with a large, diverse group of stakeholders. The selection process lasted a few months and it required a Schematic Design submission. This process forced the Design-Build proposing teams to quickly bond in order to meet this challenge, and the strength of the working relationship was apparent in the created design and in the interview. Eight Design-Assist Subcontractors were selected months in advance of construction and participated in the team charter signing. Subcontractor selection criteria was best value, not low price.

CULTURE AMONGST TEAM: The team displayed high levels of trust, respect, and transparency, plus there was a collaborative and energetic disposition amongst the team – far from adversarial. The culture was greatly assisted by clarity of roles and alignment of team objectives.

EARLY INVOLVEMENT OF PROJECT TEAM MEMBERS: Having the Design-Build team together on day one, as a joint selection, set the tone for a collaborative team as they led intense design charrettes monthly with the Owner and major Subcontractors. Visualization, through technology and early mock-ups, was utilized frequently to make decisions. Joint field investigations were performed regularly to mitigate the risk of existing conditions. Design-Assist Subcontractors focused on early identification of manufacturers, products, and systems to streamline the design process. Prefabrication strategies were discussed early as a team and incorporated in the design.

TECHNIQUES THAT ALLOWED TEAM TO OPERATE COLLABORATELY:

- Co-location: The "big room" field office concept of all the key team members in one location, with no walls, was very effective.
- Project Coach: The Owner provided a Project Coach to lead the charter development and monthly team meetings. This individual was not part of the day to day project operations.
- Team performance metrics: The team established safety, quality, schedule, cost, and RFI/submittal turn-around goals that were reviewed quarterly.
- 360 team environment surveys: The school's Architectural/Engineering Department facilitated on-line 360 surveys for topics such as trust, mutual respect, and communication. Data was presented to the team quarterly and action plans were developed to address negative trends.

RESOURCES THAT ENHANCED COLLABORATION:

- Project Management Information System (PMIS): A web-based tool to effectively track data from RFIs and submittals was easily obtained.
- Tools in the field were used to maximize efficiency (i.e. Touch screens, iPads, and BIM).
- On-line team environment surveys.

QUANTIFIABLE PROJECT OUTCOMES: Due to this project recently being completed, the PSU Architectural/Engineering Department is still conducting its research.

LESSONS LEARNED FROM THIS PROJECT:

- Early Subcontractor involvement was critical, especially with complex renovations.
- Collecting feedback routinely on lessons learned to date and implementing continual improvement adjustments is very helpful to obtaining project goals (primarily schedule).
- Driving the collaborative culture into the field level personnel is challenging, but rewarding.
- Monitoring and fostering team health with a Project Coach made the task of building with a collaborative team much easier.

THOUGHTS FROM THE OWNER:

"This project won the 2014 Architectural Engineering Institute's Professional Practice Awards for CM Excellence and Best Overall Project. The accolades were due to the acceleration of the schedule through facilitated collaboration. The first residence hall renovation was 14 months and the next three halls were accomplished in seven months each."
John Bechtel, The Pennsylvania State University

Industry Resources:

National Associations:

- American Institute of Architects (AIA)
  - AIA Center for Integrated Practice: http://network.aia.org/centerforintegratedpractice/home/ Contains many good resources such as Integrated Project Delivery Case Studies (2010 & 2012), AIA Integrated Project Delivery Awareness Survey
  - AIA IPD Contracts Information: http://aia.org/contractdocs/AIAS076706
  - The Business Case for Trust: http://www.aia.org/akr/resources/documents/AIAP062339
- Associated General Contractors of America's (AGC) Project Delivery Website: http://www.agc.org/cs/industry_topics/project_delivery
- ConsensusDOCS: Contract and other delivery resources: https://www.consensusdocs.org/
- Design Build Institute of America: Construction best practices: http://www.dbia.org/resource-center/Pages/Best-Practices.aspx
- Joint Committee of the AIA and the AGC's primer of Project Delivery, 2nd Edition: http://www.agc.org/galleries/projectd/AIA-AGC_Primer_on_Project_Delivery_2nd_Edition-FINAL.pdf
- Lean Construction Institute: http://www.leanconstruction.org/

Regional Resources:

- AIA-MBA Joint Committee Best Practices Guide: http://www.mbawpa.org/aia-mba/best-practices-guides.asp
- AIA-MBA Joint Committee Project Delivery Information: http://www.mbawpa.org/aia-mba/procurements-supplements.asp
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Additional Resources:

- Cannistraro study of 408 projects that shows collaborating with BIM can decrease change order from 18.42% to 2.68%: http://www.cannistraro.com/Newsletter%20Q3%2009(final).pdf
- CIC – Penn State University: A Comparison of U.S. Project Delivery Systems, a research study of 351 project: https://www.engr.psu.edu/ae/cic/publications/TechReports/TR_038_Konchar_Comparison_of_US_Proj_Del_Systems.pdf
- KLMK Group: Integrated Project Delivery: The Value Proposition, An Owner's Guide for Launching a Healthcare Capital Project via IPD: http://www.deecramer.com/file/KLMKIPDWhitePaperFinal2010.pdf
- Rocky Mountain Institute employs rigorous research, analysis and whole-systems expertise to develop breakthrough insights: http://www.rmi.org/

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