Maximizing Success in Integrated Projects

An Owner's Guide

Version 0.9
Release for public comment

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Executive Summary

The ***Owner's Guide to Maximizing Success in Integrated Projects*** is the application of the findings from a robust empirical study of over 200 capital facility projects. Using a variety of statistical methods to model the relationship between project delivery and project success, the primary finding of the study is that owners should consider an overall *project delivery strategy* when structuring design and construction services, rather than focus exclusively on the delivery method. By considering how the organizational structure, contract payment terms and team assembly process can work together, owners can develop a more comprehensive strategy. In particular, the study finds that those strategies which align the core project team—owner, designers, primary builder and key specialty trades—are more effective in meeting or exceeding their cost, schedule and quality goals. The study also finds that during implementation, higher performing project teams engage in *integrated practices* and develop into a *cohesive group*.

While the importance of project teams might not be a surprising insight for those with experience in the construction industry, designing team performance as part of the delivery process may seem more like random chance than thoughtful strategy. However, the data from this study shows that certain strategies produce repeatable outcomes. Three critical factors emerged for enabling alignment within the core project team: *early involvement*, *qualification driven selection* and *cost transparency* in contracts.

> ***Early involvement:*** Early involvement, not only of the primary builder, but also of key design-build or design-assist specialty contractors, is common in the delivery of successful projects. Engaging the core project team members in the design process, before advancing beyond *schematic* design, is critical to garner the full value from this approach. Early involvement also enables participation in integrated practices, such as developing project-specific goals, leading design charrettes and developing a Building Information Model (BIM) execution plan. Participation does not stop at the front end, as value was also found in the continued engagement of design team members throughout construction and project turnover.
>
> ***Qualification-based selection***: To enable early, high-quality interactions within the core project team, qualification-based selection of these team members is important. The most cohesive teams were selected after the review of relevant qualifications and after an interview process that assessed the quality of individual team members. The shift away from price-based selection criteria derived from the construction scope, toward non-price considerations, such as qualifications or interview performance, is a valuable first step in assembling a project team.
>
> ***Cost transparency***: The use of open book accounting in contracts during the delivery process proved critical in the development of trust within the core project team. While most commonly found in the primary builder's contract, this transparency was sometimes extended to the key specialty trades. Additionally, contract terms that allowed for shared risk and reward, either through financial incentives or joint-management responsibilities, were common in aligning project team interests in the delivery of successful projects.

Owners can incorporate each of these factors—*early involvement*, *qualification driven selection* and *cost transparency*—into a variety of project delivery strategies. A ***project delivery strategy*** is a high-level plan for structuring design and construction services that considers organizational structure, contract

payment terms and team assembly processes. The key to successful project delivery lies in designing a strategy that aligns the core project team with the owner's project-specific goals and needs.

After describing the empirical findings upon which our guidance is based, this guide assists in defining project goals, identifying any legal or policy constraints on the delivery process and selecting the appropriate project delivery strategy. This guide presents information to support a project delivery workshop held by the owner and key project stakeholders. The objectives of the workshop are to: (1) provide a structured approach to selecting a project delivery strategy; (2) identify opportunities and obstacles for enhancing alignment in the core project team; and (3) provide documentation of the decision process.

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Getting Started

This section of the guide provides a brief overview of project delivery and introduces several topics to orient the reader before they begin to use this guide. The guide itself focuses on selecting an appropriate project delivery strategy to design and construct a facility that *maximizes success* for the owner. The guide describes a workshop approach to selecting a project delivery strategy and provides a template in Appendix A for running the workshop and documenting the outcome.

What is an Integrated Delivery Process?

The use of the word *integration* has grown significantly in recent years, but the term is rarely defined. Integration is generally defined as the combining or coordinating of separate elements into a harmonious, interrelated whole or unified system. In the context of the delivery process for a capital facility project, an ***integrated delivery process*** is the organizational coordination or combination of design and construction disciplines in support of the project goals. However, an integrated delivery process does not exclusively require a multiparty Integrated Project Delivery (IPD) contract. The evidence from this study finds that the majority of capital facility projects are delivered with conventional contract models (design-bid-build, construction manager at risk and design-build). Pursuing the spirit of integration can be undertaken to some degree in all delivery methods, but the success of implementing integrated practices is far more likely with certain project delivery strategies than with others.

What is a Project Delivery Strategy?

A ***project delivery strategy*** is a high-level plan for structuring design and construction services. By selecting a project delivery strategy, an owner is making three critical project delivery decisions: (1) the organizational structure of the core project team; (2) the contract payment terms that define the methods of reimbursement for the work; and (3) the team assembly process. Additionally, our research finds that the owner has a role in developing an integrated team during the implementation phase of the project, both by encouraging participation in integrated practices and by building cohesion among team members. Team integration and team cohesion, which were found to be critical success factors in our empirical data, are often an implied, but rarely an explicit, consideration at the initiation of a capital project. Descriptions of these decisions and success factors are listed below.

Organizational structure: The organizational structure defines the hierarchy of the core project team, plays a critical role in establishing lines of communication, defines responsibilities and distributes those responsibilities amongst project team members.

Contract payment terms: Significant portions of design and construction contracts are focused on payment provisions, or the method of reimbursement for the work. Contract payment terms define the invoicing requirements, the method of reimbursement (whether against explicit costs or a pre-defined schedule of values) and sometimes a maximum agreed upon cost.

Team assembly process: Team assembly practices, commonly referred to as procurement or acquisition, include the approach to soliciting proposals or bids, the methods for evaluating a potential primary builder or key specialty trade and the criteria for selecting the core project team.

Team integration: From an organizational perspective, team integration is the degree to which the core design and construction team members are brought together for a common purpose. A highly integrated team will leverage the expertise of individual team members to improve the value provided in the project delivery process.

Team cohesion: The development of group cohesion is a key turning point, where newly formed groups begin transitioning into an effective team. Highly cohesive teams have compatible personalities, demonstrate strong commitment to project goals and communicate efficiently.

Summary of Research Findings

This guide is the result of a robust, statistical analysis of 204 capital facility projects. A variety of statistical methods, including a latent class analysis and structural equation modeling, were used to assess the role of project delivery, team integration and group cohesion in the performance of building construction projects. A main finding in the research was that project delivery methods *alone* (i.e., design-bid-build, construction manager at risk, design-build and IPD) did not determine success. Instead, the data showed that successful projects followed specific delivery strategies that enabled the use of integrated practices and supported the development of cohesion between design and construction disciplines. Each delivery strategy represented a distinct combination of team organizational structure, contract payment terms and team assembly practices that were selected by owners. For a more detailed description of the research methodology and analyses used in this study, a summary has been provided for reference in Appendix A.

Data Demographics

The 204 capital facility projects in this study were substantially complete between 2008 and 2014. As shown in Figure 1, the projects were geographically distributed across the continental United States. Sixty-two percent (62%) were publicly funded and thirty-eight percent (38%) were privately funded. The facilities were found across all sectors of industry, including commercial space, lodging, office, correctional, education, manufacturing, recreation and healthcare. Projects ranged in size from 5,000 square feet to over 1-million square feet, although approximately sixty percent (60%) were less than 200,000 square feet. The total completed unit cost of the facilities ranged from $50 per square foot to over $1,200. Fifty-five percent (55%) of projects reported unit costs less than $400 per square foot. These unit costs included both design and construction contracts and were adjusted for regional cost differences and indexed to 2014 dollars.

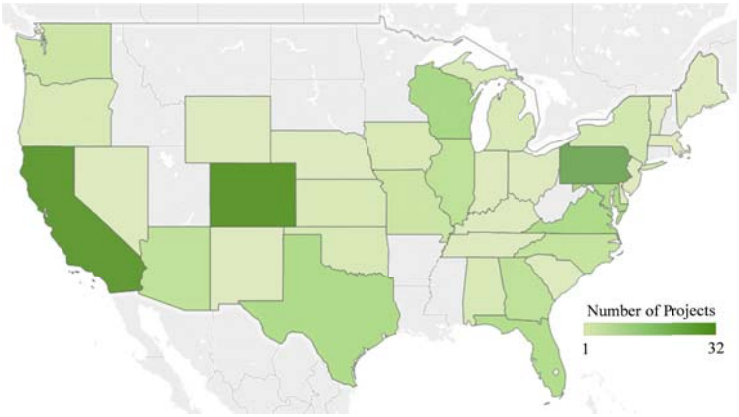


Figure 1: Location of projects in data set

Critical Success Factors

Influence of Critical Success Factors

- **70%** of projects delivered late … had below average levels of team integration.
- **60%** of projects delivered on-budget … had average or better levels of group cohesion

The development of the core project team was uncovered as a significant contributor to the success of capital facility projects. Comprised of the owner, designer, primary contractor or construction manager and key specialty trade representation from mechanical, electrical, plumbing (MEP) and structural contractors, the *core project team* was assessed along two dimensions: team integration and group cohesiveness. These dimensions were identified as critical success factors in this research. Highly integrated teams engaged in practices that brought individuals together, in multidisciplinary interactions. These practices, which included building joint goal-setting, information modeling (BIM), design charrettes and construction phase co-location, had a measurable impact on schedule performance. This impact was especially noticeable in projects with little or no team integration. Seventy percent (70%) of the projects delivered late, with over five percent (5%) schedule growth, had below average levels of team integration. Highly cohesive groups engaged in behaviors that promoted a shared culture within the project team. These behaviors, which included the formation of team chemistry, timely and reliable communication and commitment to project goals, were critical in meeting the owner's cost and quality goals. Sixty percent (60%) of the projects that delivered on-budget, or with savings returned to the owner, had average or better levels of group cohesion. Similarly, seventy-one percent (71%) of projects where owners expressed satisfaction with the facility turnover process and overall building system quality reported above average levels of group cohesion. These critical success factors were important in understanding the mechanisms by which different project delivery approaches contribute to project performance.

Classes of Project Delivery Strategy

When reviewing the data, this study discovered that many owners did not deliver projects according to the traditional definitions of common project delivery approaches (e.g. design-bid-build, construction manager at risk or design-build). However, by looking for distinct combinations of how owners organized the design and construction disciplines, defined the contract payment terms and assembled the core project team, this study found five underlying project delivery strategies. Referred to generally as Class I, II, III, IV and V, these *project delivery strategies* enabled, or detracted from, the project team's ability to leverage integrated practices and develop into a cohesive group. Figure 2 plots the five classes of strategies together, according to their potential for influencing these critical success factors, based on the front-end decisions in the delivery of a capital facility project.

Delivery strategies that enabled strong project teams along both axes drastically improved their chances to achieve their cost, schedule and quality goals. Eighty-four (84%) of projects with a Class V delivery strategy, characterized by having the highest levels of both team integration and group cohesion, reached substantial completion either on-time or early. Comparatively, only sixty-three percent (63%) of the Class I projects, with the lowest reported levels of team integration and group cohesion, could claim an on-time or early completion. At seventy-six percent (76%), the Class III strategy, with moderate team integration and high cohesion, had the highest percentage of projects delivered either on or under-budget. Class I was the least likely strategy to meet the owner's cost goals, with only fifty-three percent (53%) of those projects staying on-budget.

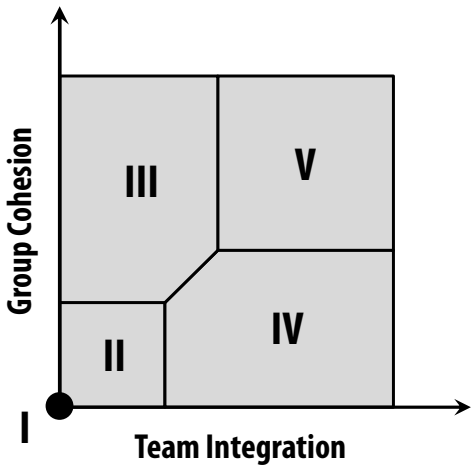


Figure 2: The relationship project delivery strategy with team integration and group cohesion

Despite the relationships found between delivery strategies and project performance in this research, *each project is unique*. There is no "one-size-fits-all" project delivery strategy that works for every owner or every facility type, and aligning project teams during the delivery process can be challenging. That is also the reason a statistical approach was used to achieve these empirical results. From the 204 projects analyzed, three themes emerged for enabling the critical success factors of team integration and cohesion within the project team:

Early involvement of the core team

Early involvement, not only of the primary builder but also of critical design-build or design-assist specialty contractors, was essential to a successful delivery. Similarly, participation did not stop at the front end for the designers. Continuous interaction throughout the construction phase, including co-location and increased sharing of BIM, were found to maintain a high level of integration after design completion. Seventy-three percent (73%) of the top 40 schedule performing projects engaged the builder during schematic design or earlier, and fifty-five percent (55%) engaged specialty trades for critical systems before schematic design.

Qualification-based selection of core team

When assembling the core project team, higher performing projects in this study *did not* select the primary builder and key specialty contractors based solely upon a bid or proposal price. Projects with the most cohesive teams focused more heavily on qualifications and used an interview process to assess the quality of the individual team members. Selection based solely on price was an indicator of the least integrated projects. This group of projects averaged four percent (4%) higher cost growth than projects where qualification-based criteria were used to select the core project team.

Transparency in cost accounting

The use of open book accounting in contracts during the delivery process proved invaluable in the development of trust within the core project team. While most commonly found in the primary builder's contract, this transparency was sometimes extended to key specialty trades. Projects using closed-book payment terms averaged two percent (2%) higher cost growth. Closed-book projects led to less satisfied owners at project turnover. Additionally, contract terms that allowed for shared risk and reward, either through financial incentives or joint-management of responsibilities, were common in the delivery of successful projects.

How to Use this Guide

This guide was developed to assist owners, their key stakeholders and core project teams in selecting and implementing a project delivery strategy that maximizes their potential for a successful project. The guide and associated workshop forms in Appendix A discuss the project delivery decisions that an owner and their team must make, with respect to their project-specific goals and constraints. This guide assumes that readers have a basic understanding of the differences in delivery methods, contract payment terms and team assembly processes. Participants in the workshop can learn about these decisions through the workshop process when facilitated by a knowledgeable owner or practitioner.

Facility owners are the intended audience for this guide, but the discussions on factors influencing successful delivery may prove useful to a variety of stakeholders in the design and construction industry. In particular, the need to extend project integration beyond the designer and primary builder interactions, to include key specialty trades and consultants was a significant factor in project success.

The selection of a project delivery strategy is one of the first steps in designing and constructing a new capital facility. Because the process requires that a large number of decisions be made early in the project, choosing the most appropriate project delivery strategy can seem daunting. However, this research identified several combinations of decisions that improve the likelihood of success and streamline the selection process. The steps in this guide follow a logical sequence, highlighted in Figure 3, and are designed to assist the owner in the selection of an appropriate project delivery strategy. First, the owner defines project-specific goals (Define Project Needs). Next, the owner reviews the opportunities and obstacles in each decision point: organizational structure, contract payment terms and team assembly processes (Explore Delivery Options). While each project is unique, and many internal and external factors influence project outcomes, careful consideration of these decision points will improve an owner's likelihood of success. Lastly, the owner identifies legal or policy constraints before selecting the most appropriate project delivery strategy (Select Delivery Strategy). The core project team is then tasked with implementing and building alignment with the delivery strategy. These steps provide a structured approach to selecting an optimal project delivery strategy.

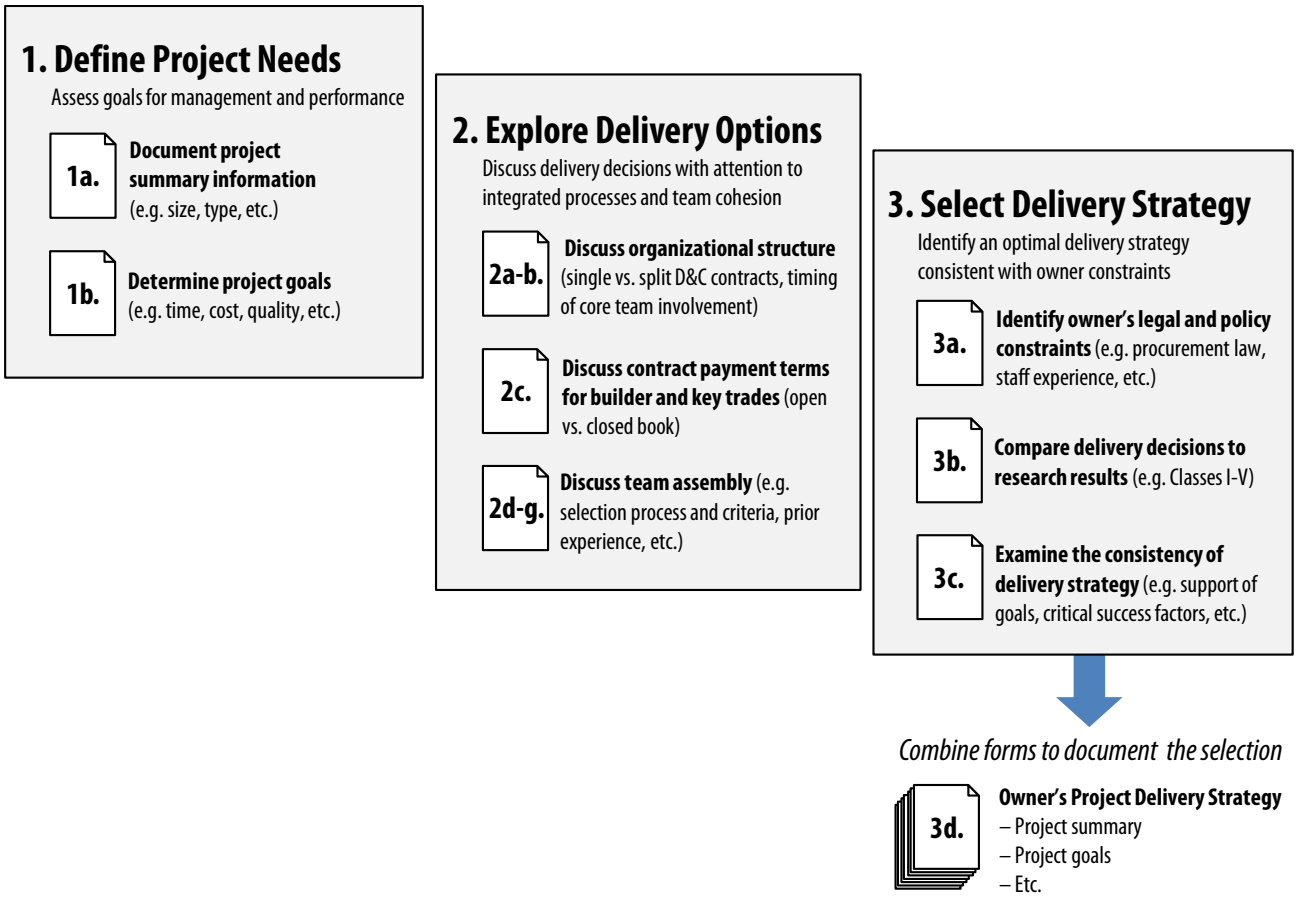


Figure 3: Project delivery strategy selection process steps

Owners can integrate these steps into their own decision-making process or use the ***Project Delivery Strategy Selection Workshop*** templates found in Appendix A of this guide. Electronic versions of the workshop templates are available for download at http://bim.psu.edu/delivery. Our experience suggests that these decisions should be made in a workshop setting with key stakeholders. A workshop enables each of the key stakeholders from the owner's organization to participate in the decision; thereby improving the likelihood to select the best-fit strategies for the project's needs, as well as ensuring a common understanding and buy-in to the strategy by the owner's team. The workshop should occur as early as possible, ideally during the programming or conceptual design phases of the project. Participation of a minimum of 3-5 people and a maximum of 12-15 is recommended, but the optimal number will vary with the proposed project's size and complexity. While the size and/or timing of the project may constrain the amount of interaction, there is still value in the workshop approach, even at the smallest scale. With repetition, one or more of the guide steps can be pre-defined and streamlined to facilitate a more rapid process. However, we strongly suggest that the key stakeholders review each step, at least briefly, to ensure understanding of the process. The sections that follow are organized to support this approach, although variations on this workshop can easily be developed and supported.

1. Define the Projects Needs

The selection of the project delivery strategy requires the owner to define a clear set of project attributes and goals at the beginning of the process. Each project is unique and the development of unique project goals, according the short process in Figure 4, will support the selection of the most appropriate project delivery strategy.

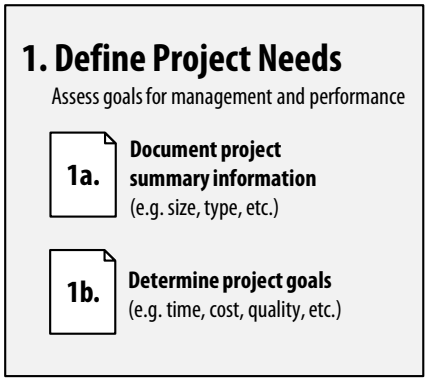


Figure 4: Summary of Step 1

1.1 Project Summary Information

Documenting assumptions and known information about the project will provide context for later discussions. The project description should be concise, but thorough. This includes the owner's space requirements, facility size, funding source, any known risks, potential complexity, preliminary schedule and initial budget. It is important to clearly denote what parts of the project description are known and what parts are based on assumptions. All parties should discuss any assumptions and their reliability with the workshop participants. If these assumptions change during the workshop, document those changes and re-visit the project goals. Found in Appendix A, ***Form 1a*** may be used as a template to organize this information.

1.2 Project Goals

An understanding of goals is essential to selecting an appropriate project delivery strategy and, ultimately, to defining project success. Therefore, project-specific goals should be set before advancing to subsequent steps in the guide. Typically, project goals can be defined in three to five items dealing with the management of the project or expected performance of the facility. Example goals are provided in Table 1. Note that these goals are long-term and should remain consistent over the life of the project. Found in Appendix A, ***Form 1b*** may be used to document your project's goals.

Table 1: Example project goals

Schedule	**Cost**
☐ Minimize project delivery time ☐ Complete the project on schedule ☐ Accelerate start of project revenue	☐ Minimize project cost ☐ Maximize scope within project budget ☐ Complete the project on budget
Quality	**Functional**
☐ Meet or exceed project requirements ☐ Select the best team ☐ Create a significant or unique design	☐ Maximize lifecycle performance ☐ Minimize inconvenience to facility users ☐ Maximize worker and user safety

2. Explore the Delivery Strategy Options

This section, summarized in Figure 5, presents the framework for making core decisions and considerations for selecting a project delivery strategy. Example opportunities and obstacles are provided for each option, but the reader should recognize that these opportunities and obstacles may change based on the project characteristics, goals and constraints.

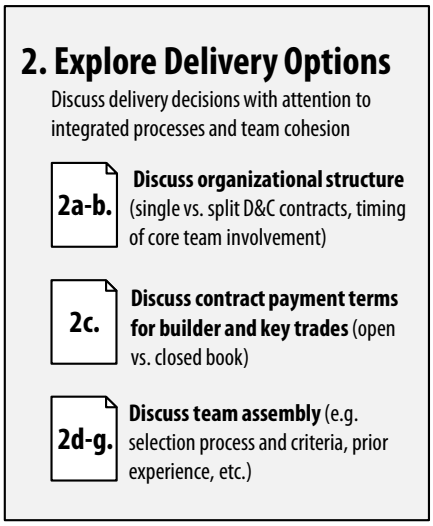


Figure 5: Summary of Step 2

2.1 Organizational Structure Considerations

A project organization is a temporary contractual arrangement of design and construction disciplines, structured by the owner and tasked with the mission of delivering an operational facility. Within the project organization, core team members belong to their parent organization, but have the added responsibility of becoming a contributing member of the project team.

This research found that two primary organizational considerations impact project success: (1) design responsibility, represented by the use of single design-build contracts or split contracts for design and construction; and (2) timing of involvement, defined as the phase of design when the owner hires the primary builder and key specialty trades. Note that opportunities and obstacles can change with each individual project.

> *Design responsibility:* When considering how to structure design and construction services, owners have two primary choices. They can choose to hire a designer and primary builder separately, using Design-bid-build or construction manager at risk arrangements, or they can choose a combined solution with design-build or integrated project delivery (IPD).
>
> *Timing of involvement:* This research found that project success was influenced by the time at which the primary builder and key specialty trades were brought into the core project team. The data was organized into three main timeframes for potential involvement: (1) before completion of schematic design; (2) after schematic design and before construction documents; and (3) during completion of construction documents or later.

With an understanding of the opportunities and obstacles unique to the project, the owner should define the design involvement of the primary builder, as well as the key specialty trades. The owner may refine the exact timing when assembling the team, but documentation of a plan for when each party should be under contract is paramount. In particular, defining the specialty trade contractors whose input in the design process may prove valuable for the facility goals, as well as defining the constraints on when certain parties can be involved should be defined. Found in Appendix A, **Form 2a** and **Form 2b** may be used to document your decisions related to design responsibility and timing of involvement, respectively.

2.2. Contract Payment Terms and Considerations

Contract payment terms are the contractual provisions for how an owner will pay the primary team members for their work. These provisions define the requirements, obligations and responsibilities of the parties; the allocation of project risk; and the payment procedures. Key elements include the estimation of work, measurement of work in place and payment for the work upon acceptance by the owner.

This research found that the contract payment terms influence project success. The key decision when considering payment terms is cost transparency (i.e. the use of open-book or closed book accounting). Projects in this research with greater cost transparency had core project teams that were more cohesive. The underpinning of this decision focuses on risk. In an open-book approach, the design and construction risks, as well as the costs to help manage those risks, are transparent. In lump sum contracts, the owner and project team may discuss the risks, but builder and specialty trades primarily hold the financial risks. Based on the evidence from our empirical analysis, owners who do not have legal or policy constraints against cost transparency would increase their likelihood for project success if they chose contract payment methods with greater cost transparency. The ability to more directly plan and make design decisions based upon the project financial risks is supported by open-book accounting.

> *Cost transparency*: An "open book" approach indicates that the payment terms are typically cost-reimbursable, either through a cost-plus-a fee contract, or possibly with a guaranteed maximum price. In open-book accounting, team members are paid for completed work based upon the cost of the work in place, plus a fee for the services performed. During the design and preconstruction process, the owner and project team members participate openly in the cost estimation and project budgeting. Closed-book accounting requires only a lump-sum scope for the whole project in conjunction with a schedule of values for payment means. Lump sum contracts reduce the management burden of the owner when the project reaches construction by reducing the accounting effort necessary on the owner's part to perform the detailed verification of the costs.

With an understanding of the opportunities and obstacles, the owner should define the payment terms for the lead builder and key specialty trade contractors. This is particularly true if the builder and contractors share a contract with the design team. In addition, there could be a transition between open book and closed book strategies when moving from design to construction. In particular, defining the constraints and approach to managing the financial risks for certain parties is critical. Found in Appendix A, **Form 2c** may be used to document your preference of payment terms.

2.3. Team Assembly Considerations

As previously stated, a project organization is a temporary contractual arrangement of design and construction disciplines. The owner has a variety of options to assemble the team, from seeking one sole source for design and/or construction, to opening the project to the lowest bidder. Most owners, however, have some constraints in how they assemble the team, whether it is legal, policy-based, cultural or functional.

This research found that the manner in which owners assemble the team impacts project success. The decisions that proved to be statistically significant in this research are (1) the inclusion of non-price

(qualification) factors instead of price only selection criteria; (2) shortlisting instead of open procurement; (3) previous experience with the owner instead of first-time projects; and (4) the use of primary builder and key trade interviews prior to selection.

Selection process: Owners can use a spectrum of methods to select the team that range from a sole source selection to an open bidding selection without narrowing the field. The best performing projects in our study used two-step selection processes. Narrowing the potential pool of designers or builders on the basis qualifications was common on successful projects (i.e., shortlisting). Shortlisting involves a two-step process in which the firms indicate their intent to bid and provide the requested documentation of qualifications. This step occurs prior to receiving a price and/or technical proposal from the team. In the second step, the shortlisted firms are asked to respond with a proposal or bid, as appropriate to the final selection criteria.

Selection criteria: The inclusion of non-price selection criteria in team assembly practices had a statistically significant impact on project success. Owners typically select designers based upon qualifications. In fact, public owners can be required by law to exclude price when hiring a designer. However, owners use a full spectrum of price and non-price factors to hire builders. The non-price factors can involve value-added design, construction management approaches or qualifications for the work and facility type. This research found that those owners who use non-price factors had a higher chance of success.

Prior experience with owner: While this research did not identify how owners choose repeat business partners, those owners who worked with the same primary builder on multiple projects were more likely to achieve their project goals. Working with the same core project teams for repeat work creates a reduced learning curve and carries over developed relationships that can start projects off in a better position for success. In addition, firms that have an incentive through repeat work will be more likely to seek win-win solutions rather than putting short term financial interests first.

Interview process: The use of an interview implies that the owner is using non-price factors in the selection of the primary builder and potentially the key specialty trades. Interviews can range from simple clarifications of the proposal to questions about complex scenarios that a design or construction team member may encounter during the project. Those owners in our study who did conduct interviews found better project success across most project delivery strategies.

With an understanding of the opportunities and obstacles, the owner should define the process and criteria for assembling the project team early in project development. The decisions should focus on the elements where the process may be constrained. The decisions should also document criteria needed to justify the decision either publically or internally. It is of the utmost importance to clearly define criteria for the selection of new team members. Otherwise, particularly with the qualification driven approaches, owners may struggle to limit biases from the participants in the selection process. Found in Appendix A, **Form 2d** and **Form 2e** may be used to document decisions related to the selection process and specific selection criteria, respectively. Prior working experiences may be documented in **Form 2f** and discussions related to the use of an interview process in **Form 2g**.

3. Select the Project Delivery Strategy

This section provides guidance for translating the owner's preferences from the previous section into an appropriate project delivery strategy. While exploring the options in organizational structure, contract payment terms and team assembly processes, there is a tendency to default to the most familiar options. The goal of this section is to assist the owner in selecting a project delivery strategy that is both compatible with their legal or policy constraints and provides the greatest likelihood of meeting their project-specific goals. This process is summarized in Figure 6.

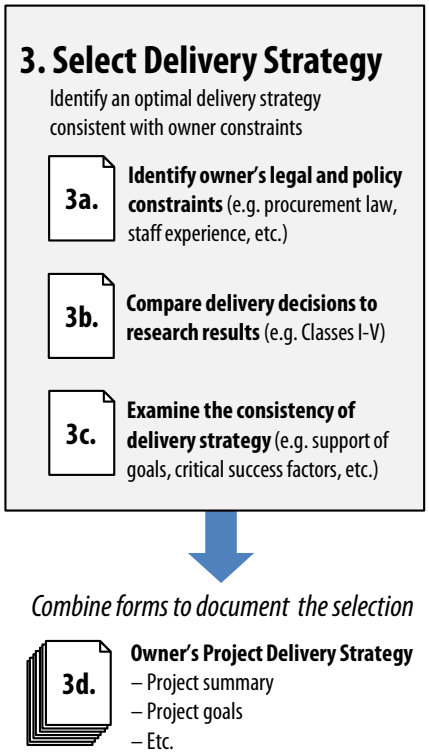


Figure 6: Summary of Step 3

3.1 Identify Project Constraints

Owner, or project, constraints exist on each project. These can limit or even preclude the use of certain project delivery strategies. Listing these constraints prior to focusing on a single delivery strategy can make the selection process more concise, as well as focus the discussion of where the process can be improved within the defined constraints. Found in Appendix A, **Form 3a** provides a list of constraints, which are related to functional requirements, laws, policy and even the culture within the owner's organization. The goal of this step is to eliminate those delivery strategies that are incompatible your project-specific constraints. During this discussion, a minimum of between one and three viable delivery strategies should emerge. These viable delivery strategies can accommodate your constraints and are candidates for further consideration.

3.2 Determine Viable Project Delivery Strategies

The next step in selecting a delivery strategy is to compare the owner's documented preferences for organizational structure, contract payment terms and team assembly process against the list of viable delivery strategies. Found in Appendix A, **Form 3b** is designed to assist with this comparison. Each of the five project delivery strategies is defined by a set of owner decisions that structure the design and construction services on a project. The following subsections briefly describe each delivery strategy, with an emphasis on those specific owner decisions that differentiate between strategies.

3.2.1 Class I

Owners following this strategy hold separate design and construction contracts. Both the general contractor and key specialty trades are selected with an open bid process, after the completion of the design. They are selected exclusively on price-based criteria for the construction scope. While there was no constraint on

Class I
- ✓ Separate design and construction contracts
- ✓ Open bidding
- ✓ Optional prequalification
- ✓ Closed book, lump sum contracts
- ✓ DBB delivery

the pool of bidders for the general contractor, either through prequalification or a two-stage process, the key specialty trades were sometimes prequalified by the general contractor. The contract payment terms were closed book, lump sum agreement for both the general contractor and key specialty trades. The Class I strategy best aligns with a traditional, design-bid-build approach.

3.2.2 Class II

Class II
- ✓ Separate design and construction contracts
- ✓ Builder involvement in DD or CD
- ✓ Best value selection
- ✓ Prequalified team
- ✓ Closed book, lump sum contracts
- ✓ DBB and CMR delivery

Owners with a Class II delivery strategy also hold separate design and construction contracts. However, the construction manager or general contractor may become engaged before design completion, either during design development or finalizing construction documents. Some key specialty trades may also be engaged, generally if the building systems require constructability input or if a specific work package is released before the entire design is complete. The selection of the construction manager or general contractor and key specialty trades is primarily based on competitive price for the developed design. There is some emphasis on qualifications during team assembly, typically with a prequalification process prior to bidding, or by selecting the construction manager or general contractor based on a best-value approach. Closed book, lump sum payment terms are commonly used for the construction manager or general contractor and the specialty trades. The Class II strategy best resembles a design-bid-build approach with builder involvement design development or construction documents phase. Class II could be alternately be considered a late hired construction manager-at-risk approach.

3.2.3 Class III

Class III
- ✓ Separate design and construction contracts
- ✓ Builder involvement in SD or earlier
- ✓ Qualification-based selection of builder
- ✓ Prequalified team
- ✓ Open book, GMP contracts
- ✓ CMR delivery

Owners following this strategy typically hold separate design and construction contracts. The construction manager is hired very early in the design process, often during schematic design or earlier. The key specialty trades are not contracted as early, but they see increasing participation (compared to Class II) in the design development and construction document phases for important building systems and work packages. The construction manager is typically selected through an RFP process, with an emphasis on qualifications to provide support during the design process, as well as lead the construction scope. The proposals are likely to include a competitive fee and general conditions estimate, although some owners also use a best-value approach that gives some weight to the price of the construction scope. The key specialty trades are primarily selected using a best-value approach that combines a price for their scope of work, alongside their qualifications and/or technical proposals. The construction manager is reimbursed using an open book, cost-plus-a-fee contract, typically with a guaranteed maximum price. The key specialty trades are compensated through closed book, lump sum contracts, though an open book approach may be used through design and converted to lump sum for construction. The Class III strategy best aligns with a construction manager-at-risk approach, with very early builder involvement.

3.2.4 Class IV

Class IV
- ✓ Single design and construction contract
- ✓ Builder and trade involvement in SD or earlier
- ✓ Prequalified team
- ✓ Closed book, lump sum contracts
- ✓ DB delivery

The Class IV strategy is characterized by a shift toward combined contract arrangements for design and construction services. The primary builder, whether as a single firm design-builder, designer-builder joint venture or contractor/subcontractor entity, is hired by the owner before starting schematic design. The key specialty trades are also engaged early in the design, typically before schematic design. The number of design-build teams competing for the project is reduced with a prequalification process and the winning team is often selected using best-value approach that considers the proposed design, qualifications and competitive pricing. The contract payment terms, for both the primary builder and the key specialty trades, are closed book, lump sum; however, guaranteed maximum price terms are occasionally preferred by the owner. The Class IV strategy best resembles a lump sum, design-build approach.

3.2.5 Class V

Class V
- ✓ Single design and construction contract
- ✓ Builder and trade involvement in SD or earlier
- ✓ Qualification-based selection of team
- ✓ Prequalified team
- ✓ Open book, GMP contracts
- ✓ DB, CMR and IPD delivery

Owners following this strategy typically hold a single contract for design and construction. This class included IPD contracts and a small percentage of cases where the owner contracted separately for design and construction services. The primary builder and key specialty trades are both hired before schematic design and commonly during the owner's pre-design or programming phase. There is a strong focus on qualification-driven selection, as both the primary builder and key specialty trades are selected almost exclusively on qualifications, or qualifications and fee. Price of work is rarely considered when selecting the core project team. The contract payment terms with the primary builder and many of the specialty contractors were open-book, typically cost-plus a fee with a guaranteed maximum price. The Class V strategy best resembles a target value approach with a design-build or IPD contract.

3.3 Examine the Consistency of the Project Delivery Strategy

The final step in selecting a project delivery strategy is to examine on the consistency of the owner's delivery preferences with the project-specific goals, the themes found in successful strategies and the critical success factors identified in the research. Within the narrowed list of viable project delivery strategies, the owner's preferences may not always align perfectly with a defined class discovered in our research. While the use of a class is not a requirement, these classes represent the most common approaches in our research and support the critical success factors. When trying to finalize a delivery strategy, the owner and their stakeholders should lean towards decisions that support the three themes found in the most successful delivery strategies—early involvement of team members, transparent cost accounting and qualification-based selection. Additionally, there is value in understanding the critical

success factors associated with each project delivery strategy to reflect upon which best support the project goals. Found in Appendix A, **Form 3c** is provided to document this step in the process.

3.3.1 Critical Success Factors

As previously stated, each project is unique and no single project delivery strategy is best for all owners or facility types. Those strategies that developed a strong, core project team—owner, designer, primary builder and key specialty trades—were more successful in meeting or exceeding cost, schedule and quality goals. During the implementation phases, the study also found that higher performing project teams participated in *integrated practices* and developed into a *cohesive group*. To expand on these relationships, Figure 2 provides a summary of statistically significant correlations between project performance outcomes and the two critical success factors for project teams—participation in integrated practices and development of a cohesive group.

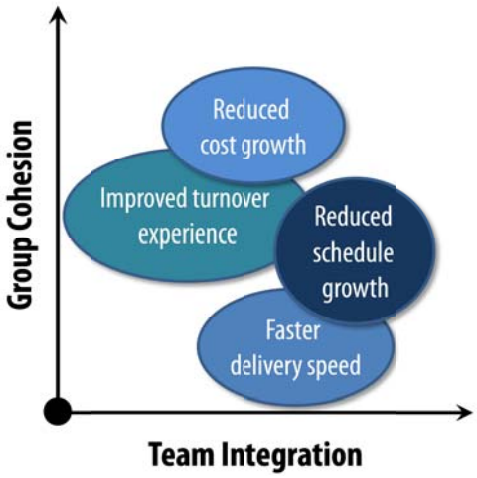


Figure 2: Relationship of goals to critical success factors

After initially defining a delivery strategy, the team of stakeholders should review their project-specific goals to ensure that the strategy supports the critical success factors associated with those performance outcomes. If the project-specific goals are more cost or quality focused, then the selected delivery strategy should promote moderate to high group cohesion. If the project-specific goals are more schedule oriented or timeline driven, then the selected delivery strategy should enable moderate to high engagement in integrated practices. The following sections summarize these two critical success factors, which were identified empirically by comparing differing levels of project success across the 204 projects. It should be noted that, while the design of the most appropriate project delivery strategy is critical to enabling the success of the project, the success of the project is never guaranteed. The research also found that the development of core project team alignment with the owner's goals does not stop at the project delivery decision or team assembly. It is an ongoing process that demands team engagement throughout all phases of the project.

3.3.2. Participation in Integrated Practices

The practices that were found to be statistically significant drivers of integrated teams include increasing team participation in the following practices: joint goal-setting, design charrettes, BIM execution planning and construction phase co-location of key team members. In addition, an increased focus on rich information sharing, suggested by more robust uses of BIM content, was critical to early and frequent communication among the core project team.

Based on the project delivery strategy selected, or the identified constraints, the integrated practices in Table 2 provide avenues for increasing the interdisciplinary interaction within the project team. While opportunities for involving the entire core project team may be constrained by certain delivery decisions, the implementation of collaborative tools can provide value for the project team. The mechanisms for implementing these tools may vary. For example, if a co-location approach is desired for construction,

but a low bid selection of key specialty trades is required by law, the general requirements of the contract specification can outline co-location requirements during the project. If the delivery approach involves early interaction of the constructor and trades, the details of the approach to co-location can be discussed collaboratively at the onset of the contract.

Table 2: Recommended integrated practices and their benefit to project teams

Integrated Practice	Benefit to Project Team
Joint goal-setting	• Allows team buy-in and nuance of goals for the project • Team participation allows clarity and alignment across all parties
Design charrettes	• Participation in design charrettes allows core support of design concepts • Greater participation increases the diversity of ideas and thoroughness of input at earlier stages
BIM execution planning	• The development of a BIM execution plan allows the sharing of design information and development process • Draft or template BIM execution plans can be used to define project expectations during procurement
Increased implementation of core BIM Uses	• Increased targeting of BIM uses enforces greater planning and communication of the information being developed • More fundamental use enables easier targeting of additional uses dependent on core model information
Co-location	• Shared work space offers quicker and richer communication amongst team members • Co-location allows development of team dynamics in addition to project communication

3.3.3. Group Cohesion

The development of a cohesive group is critical to the assembly of successful project teams. Participation in integrated practices was significantly correlated with the development of more cohesive groups. The cohesive behaviors that were observed in successful projects are described in
Table 3. Alongside with planning an approach towards integration, an ongoing commitment to aligning a cohesive project team is essential to delivering a successful project. The behaviors most associated with cohesive groups were a shared commitment to project goals, timely and effective communication and strong team chemistry.

Table 3: Recommended cohesive behaviors and their benefit to project teams

Behaviors in Cohesive Teams	Benefit to Project Team
Commitment to project goals	• Commitment to the *project* goals, instead of individual goals, promotes collaboration • Participation in goal development leads to a sense of "ownership" by project team members
Timely and effective communication	• On-going tracking and focus on timely communication can increase awareness and emphasis, as well as identification of challenges early • Timely owner communication enables the core team to mitigate cost growth and improve the turnover experience
High team chemistry	• An ongoing focus on team development and thoughtful on-boarding of new team members can enable the development of team chemistry • Inclusion of core team members at key milestone events, which may in-fact be outside their specific discipline, can maintain team engagement and increase chemistry

3.4 Maximizing Integration and Cohesion in each Project Delivery Strategy

With the most appropriate delivery strategy identified, decisions can be made to maximize integrated practices and group cohesion. These decisions should be made early to ensure incorporation into the project timeline. Specific attention should be paid to the timing of involvement for the construction manager or general contractor and key specialty trades, steps toward full definition of the core team member selection criteria and planning the contractual approach. The process for selecting a delivery strategy is intended to match delivery preferences, project goals and specific constraints with the most appropriate method for structuring the core project team; however, the implementation rests in the hands of the owner and their project team. This section explains how integrated practices and group cohesion can be advanced in each of the five delivery classes.

3.4.1 Class I: Low Group Cohesion, Low Participation in Integrated Practices

To improve participation in integrated practices, thoughtful development of onboarding requirements, co-location and use of requirement for collaborative process tools, such as BIM execution plan development through minimum model use requirements, or pull planning processes, can be built into bidding requirements. These efforts ensure awareness of the expectations as well as encourage the need to interact in planning the necessary information sharing and interpersonal interaction amongst the team to help facilitate collaborative interactions. In addition, expectations for co-location of design team members during construction should be defined early in the design procurement.

Class I Enhancements

Integrated practice considerations

- Pull planning
- BIM execution plan

Team cohesiveness considerations

- Prescribed, or set performance measures for, information sharing

3.4.2 Class II: Low Group Cohesion, Low Participation in Integrated Practices

In addition to what was previously recommended in Class I, to improve participation in integrated practices when operating a Class II strategy, the core project team should look for opportunities to promote interaction across firms and disciplines. While involvement in design charrettes or BIM execution planning may not be possible from the outset, these practices should be considered through a different lens. For example, the BIM execution plan is not a historical document, but rather an evolving plan for how models will be used to support the project. The plan should be updated when the primary builder and key specialty trades are contracted. Similarly, construction phase co-location is not exclusive to a single project delivery strategy and may be initiated under any model. However, if used in Class II, co-location must be specified as a requirement in the RFP or bid documents when selecting the construction side of the core project team. Similarly, co-location should also be addressed in the designer's proposal requirements to ensure that the designers budget appropriately for the time they will be needed on site.

Class II Enhancements

Integrated practice considerations

- Co-location during construction

Team cohesiveness considerations

- Interview primary builder
- Kick-off meetings to re-affirm project goals

To assist in the development of group cohesion within the core project team, the owner should seek methods for improving team chemistry, commitment to project goals and the quality and effectiveness of communication. Team chemistry can be vetted through an interview process, not only of the primary builder but also of the key specialty trades. In addition, involving the designer in the selection of the primary builder can identify positive chemistry, or potential conflicts and cultural differences, between potential team members. Once team members are selected, the owner should host a kick-off meeting with the core project team to re-assess the project goals and processes to be used to align the team through construction. Communication protocols should be planned out in detail. While the written contract often dictates maximum request for information (RFI) and submittal response times, these durations are not always optimal for team communication. Similar to physical or virtual mock-ups, communication protocols should be tested with each of the key specialty trades and the primary builder. The goals of testing the communication protocols is to vet the best approach and identify the types of information that the designers need to effectively respond to a submittal or RFI and the targeted turnaround times they will work to achieve.

3.4.3 Class III: High Group Cohesion, Moderate Participation in Integrated Practices

Class III Enhancements

Integrated practice considerations

- Co-location of CM/GC during design

Team cohesiveness considerations

- Interview key trades

With the earlier involvement of the builder, Class III naturally enables the development of improved group cohesion between the construction manager or general contractor with the design team. It has the potential to create a strong sense of team and commitment to the project's success. The two primary drivers for this increase lie in the early, qualification driven selection of the primary contractor. This difference in strategy allows the primary builder to be more fully involved in the design process, reducing adversarial relationships and building trust through open-book accounting of construction costs. The extension of the qualification focus to key specialty trades, and taking opportunities to involve them earlier to gain design feedback in a more timely manner can offer rich value

in the planning and constructability of the final design. Similar strategies to Class I and II suggestions should be considered for increasing engagement of specialty trades, such as involving designers in key trade selection processes and re-affirming and refining project goals or BIM execution plans as new team members join.

3.4.4 Class IV: Moderate Group Cohesion, High Participation in Integrated Practices

Class IV achieves higher levels of participation in integrated practices by involving not only the primary builder, but also the key specialty trades in early goal-setting, design and planning activities. The core project teams in Class IV were very successful in achieving the project goals in complex facility types and projects with intense schedules. The expectations for integrated practices can be communicated through request for proposal documents, to encourage proposing teams to work toward processes and participation that will support these desires by the owner. In addition, the need to focus on team development can be increased throughout the project. This can be accomplished by defining on-boarding procedures for new team members and continuous improvement of the team's communication.

Class IV Enhancements

Integrated practice considerations

- Participation in goal setting
- Co-location of core project team during design and construction

Team cohesiveness considerations

- Finalize core team early
- Team building activities that focus on personal interactions

3.4.5 Class V: High Group Cohesion, High Participation in Integrated Practices

The Class V strategies typically have sound fundamental alignment of the core project team, both in terms of participation in integrated practices and development of group cohesion. The combination of early involvement of the core project team, open book accounting approaches and strong participation in collaborative processes, led to Class V projects having the highest likelihood of achieving cost, schedule and quality goals. Despite these strong initial elements, there is always the potential for challenging team dynamics. The focus, once project teams are selected, needs to be on developing the collaborative design and planning processes, sharing information and capturing decisions in clear, concise documents. Developing cross-functional teams that span firms and disciplinary lines can support more integrated practices and streamlined decision making. Also, developing proficiency in use of collaborative tools and processes can help teams identify the best methods for capturing and sharing key information, as well as soliciting input effectively from the full array of stakeholders involved. Ultimately, the need to continuously focus and evolve the team dynamic should be a focus throughout the design and construction process.

Class V Enhancements

Integrated practice considerations

- Define cross-functional team(s)
- Pull planning during design

Team cohesiveness considerations

- Core project team involvement in selection of later trades
- On-boarding process
- Continuous improvement of core project team

3.5 Summarizing Your Project Delivery Strategy

At the conclusion of the workshop, the owner and projects stakeholders should document the project delivery strategy selection process. Found in Appendix A, **Form 3d** the *Executive Summary of Project Delivery Strategy* is designed as a high-level summary for the major decisions and discussion points made

during the workshop. A project delivery selection report can be created by fixing this summary sheet in front of the other forms in the order in which they were completed. This report will serve as documentation of the project delivery strategy selection and outline the key steps in crafting the solicitation documents and contracts for the project.

Conclusions

This ***Owner's Guide to Maximizing Success in Integrated Projects*** provides a structured approach to selecting a project delivery strategy that is based on empirical evidence from more than 200 capital facilities projects. The research found that the lines between standard delivery methods are becoming blurred. Owners should think of project delivery strategies that thoughtfully consider how the organizational structure, contract payment terms and team assembly process can work together.

Three themes emerged for enabling alignment within the core project team: *early involvement*, *qualification driven selection* and *cost transparency* in contracts. Owners should incorporate these themes into their delivery strategy to the greatest extent possible, given their project-specific goals and organizational constrains.

The study also found that, during the implementation phases, higher performing project teams participate in *integrated practices* and develop into a *cohesive group*. More integrated practices resulted in faster delivery speed and reduced schedule growth. Greater group cohesion led to reduced cost growth and improved turnover experience. Owners should seek to maximize the opportunities for these practices when developing their project delivery strategy and throughout project execution.

The appendices of this guide provide instructions for a structured project delivery workshop. The appendices also include workshop forms that provide a step-by-step approach for implementing the results of this research. The research found that no one project delivery strategy is appropriate for all projects. Rather, project-specific goals and constraints will determine the optimal delivery strategy. The results of this research show that owners should seek to maximize integrated practices and group cohesion to the greatest extent possible in all project delivery strategies.

The authors of the guide would like to acknowledge that this document was made possible through the contributions of the more than 300 owners and industry professionals who provided data from their completed projects. The authors welcome and encourage any comments that will help us to improve future versions of the guide. The most current version of the guide, and a forum for providing feedback, will be maintained at http://bim.psu.edu/delivery.

Appendix A: Research Methods and Analysis Process

This appendix describes the research methods and analysis process. While concise, the description provides enough detail to develop an understanding of the empirical evidence that drives the results. The description conveys the robustness of the research and highlights both the strengths and limitations of the findings when applying the process within the guide. For a complete description of the research methodology, the full research report is available for download from the Charles Pankow Foundation website, www.pankowfoundation.org/grants.cfm, Grant #02-12.

Study Overview

The goal of the study was to determine, analytically and without bias, the role of project delivery and team integration in project success. The study was designed to measure the influence of successful owner practices regarding roles, team integration, team behavior, delivery method, procurement method and project performance in the building design and construction industry. While the contribution of similar previous studies is frequently cited in literature and practice, the seminal studies were beginning to lose relevancy for several reasons. In the last decade, new evolutionary process improvements, such as sustainable design, building information modeling (BIM) and lean construction have gained traction. And, while prior empirical studies considered the relationships between project delivery, procurement and payment, no single study has investigated the combined effect of these factors on project performance with a large number of projects.

Research Steps

The research was conducted in three main steps:

(1) Develop and test the data collection instrument
(2) Collect data and verify responses
(3) Perform data analysis
    a. Factor analysis and clustering
    b. Structural equation modeling

Developing the Data Collection Instrument

To develop the data collection instrument, the research team used a structured workshop or "research charrette" to expand on and prioritize the preliminary list of variables. The research charrette has several benefits over traditional surveys: providing an environment for industry experts to interact in a structured manner; using multiple data collection strategies in a single setting; obtaining the responses in a short amount of time; and forming a committee using non-random sampling method focused on volunteer experts. A two-day charrette workshop was held to develop the preliminary list of performance metrics and influential variables and to prioritize their importance and availability. A panel of experts was invited to attend, with participation including two CM/GCs, two specialty contractors, three owners (two private and one public), two lawyers and one architect. The panelists were selected to represent the interests from major industry groups (e.g. Design-Build Institute of America, Construction Management Association of America, Associated General Contractors of America, American Institute of Architects, among others); all attendees had at least 15 years of experience in the construction industry.

Several steps were taking to refine and validate the data collection instrument. Structured evaluations were conducted to rate the importance and availability of performance metrics and critical success factors. The results of the evaluation were used to refine the scope of the data collection procedure and select the most important and reliable variables. The results assisted the team in identifying comprehensive variables and refining the list to a manageable number for data collection questions. The questionnaire was tested using both internal (four projects) and external (ten projects) pilots. The tests served to verify the availability of the information being requested and identify potential misunderstandings in the specific wording of questions.

Data Collection and Response Verification

To collect a broad cross section of industry projects, the developed questionnaire was distributed to professional organizations within the architecture, engineering and construction industry. Mailing lists and email listserv distribution were used to solicit participants. Response rates by mailing list and electronic distribution ranged between 1.6% and 4.8%. Since any one respondent may not have full knowledge of a given project, a verification process was followed to confirm data from the survey responses. To ensure quality of responses, each completed questionnaire was first reviewed for missing or inconsistent data. Annotations with clarifying questions were attached to the questionnaires to support verification calls, with emphasis on contract values and schedule dates. For each response, a follow-up call was arranged with the respondent to confirm the understanding of the submitted questionnaire and make any modifications needed to align the survey data with the database requirements. There were additional calls made to collect information from other parties on each project, e.g. quality ratings were solicited specifically from the owner.

A total of 331 questionnaires were received. A Microsoft Access® database was created to capture and store questionnaire responses. Following the verification of data with the respondents, the aggregate data was screened before analysis. Missing data were coded to alert analysis programs to exclude those values. Projects with more than 30% missing data were removed. In addition, projects outside the scope of the study, such as renovation projects, international projects, civil and highway work, projects which were not yet substantially complete and projects less than 5,000 gross square feet were also removed. Any projects which could not be verified with the owner were also removed. Lastly, the descriptive statistics for each variable were examined to identify any out-of-range values for means, medians, minimums and maximums. A total of 204 questionnaires qualified for analysis.

Data Analysis

This research used a combination of multivariate modeling techniques to analyze the data. First, a latent class analysis was performed to identify underlying categorical groups that corresponded to patterns in procurement and contracting variables, resulting in the classes of project delivery strategies. The measurement models for team integration and group cohesiveness were validated using confirmatory and exploratory factor analyses. Lastly, structural equation models were calculated and compared based on model fit and explained variance. All statistical analyses were performed with MPlus Version 7.2 and pairwise deletion of missing data.

Multivariate Factor Analyses

Latent class analysis uses a clustering algorithm to identify underlying, categorical subgroups or 'classes' in a sample. Classes are defined by the presence or absence of indicators, expressed as a probability, that differentiate one class from another. The purpose of this analysis was to better represent construction project delivery as a strategy, using variables known to impact the structure of project team. These variables were reduced to a set of binary indicators and an exploratory latent class analysis was run to remove weak differentiators of class. Multiple class models were formed. On the basis on fit and selection indices, the appropriate number of classes was chosen to represent the data. Lastly, each project was assigned to the class with its highest probability of belonging.

The measurement models for representing team integration and group cohesion as latent factors were tested using both an exploratory and confirmatory factor analysis. The purpose of factor analysis is to group highly inter-related, or correlated, variables into a smaller number of unobserved *factors.* During the exploratory factor analysis, several measurement variables were found to be not representative of the latent factors of team integration and group cohesion and were therefore removed from further analysis. The confirmatory factor analysis was tested using two fit indices—the root mean square error of approximation (RMSEA) and comparative fit index (CFI). The final model, shown in Figure A-1 confirmed the relationships of the remaining variables and identified a positive correlation between team integration and group cohesion. A similar approach was used to generate factors for representing the quality outcomes.

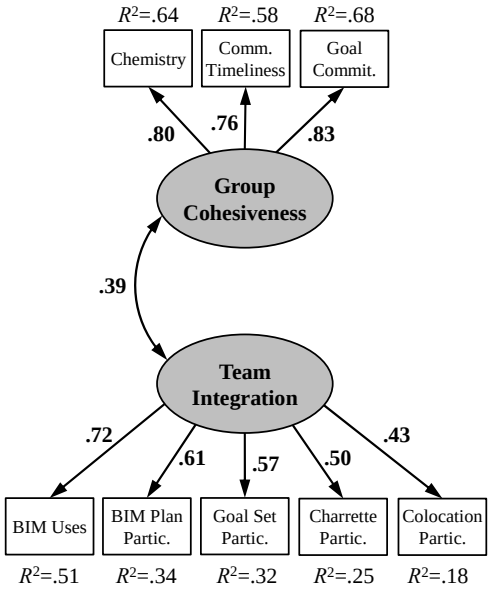
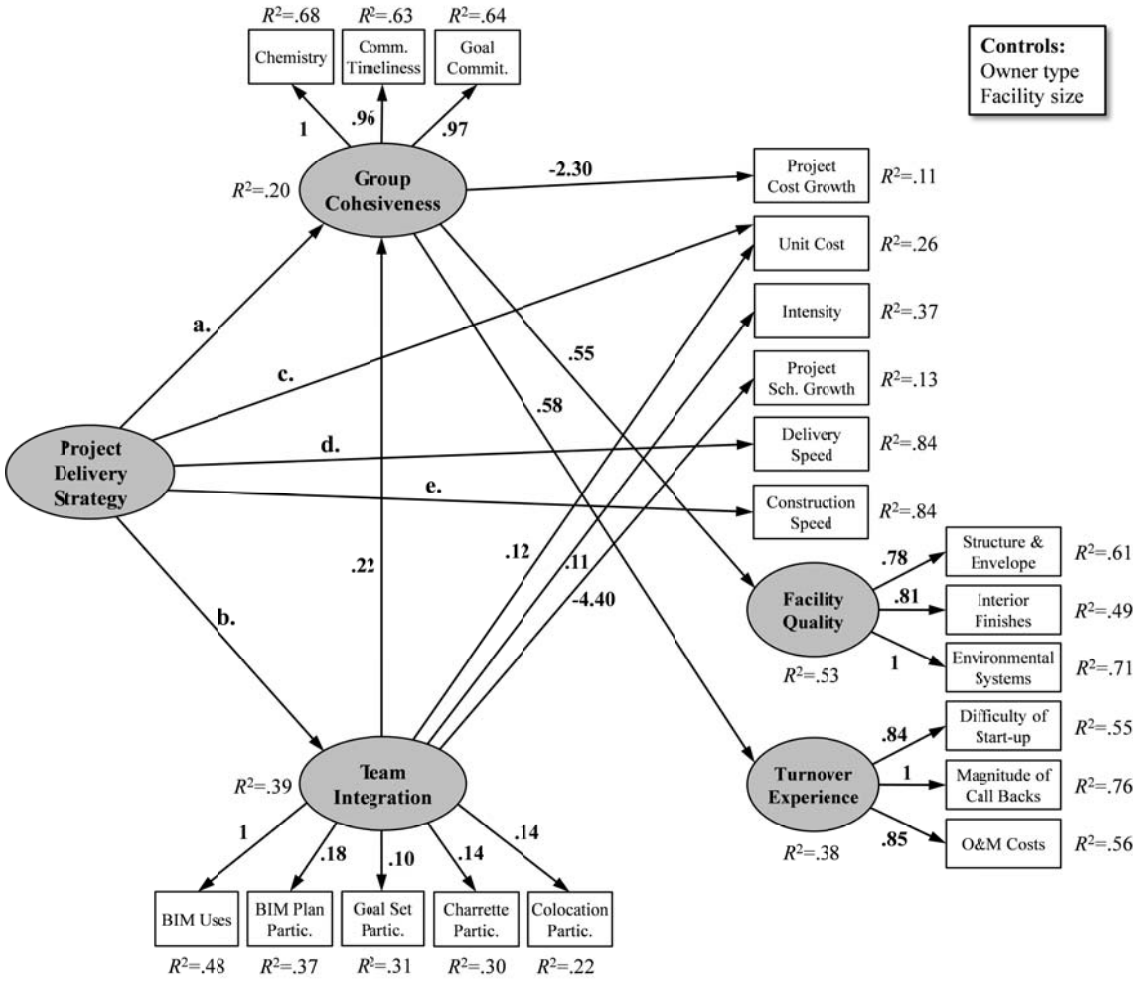


Figure A-1: Standardized factor model of group cohesion and team integration.

Structural Equation Modeling

To consider all the possibilities of variable relationships, a series of structural equation models were run and compared based on model fit and explanation of variance. A weighted least squares with mean and variance adjusted estimator (WLSMV) was used to calculate path coefficients. The WLSMV estimator is more robust when modeling a combination categorical and continuous data. The final structural equation model, shown in Figure A-2, contains three focal blocks: (1) the classes of project delivery strategy; (2) the team factors of *integration* and *group cohesiveness*; and (3) the project performance outcomes. In addition, the model was controlled for differences in facility size and type of project owner. An array of models was tested using combinations of the three blocks, and the exclusion or inclusion of the control variables. The best fitting model included all focal blocks and the control variables, and not only had an acceptable fit (CFI=0.99; RMSEA=.03), but also had high percent of variance explained (R^2) for each outcome variable.



Notes: (⟶) denotes a significant path, $p<.05$; Goodness-of-fit summary: $\chi^2_{(204)}/df=218.2$, $p=.09$, CFI=.98, RMSEA=.03

Standardized estimates by latent class of Project Delivery Strategy (paths marked **a.** - **e.**) are summarized in the table below.

Regression Path	Estimate	S.E.	*p*-value
a. *Team Environment* ON			
Closed Book CM	.40	.28	.15
Open Book CM	.59	.31	.06
Closed Book Team	.49	.31	.11
Open Book Team	.78	.32	.01
Facility size (Log)	.12	.15	.43
Public owner	.08	.15	.59
b. *Team Integration* ON			
Closed Book CM	.59	.36	.10
Open Book CM	1.35	.38	.00
Closed Book Team	1.65	.39	.00
Open Book Team	1.53	.41	.00
Facility size (Log)	.67	.16	.00
Public owner	.34	.18	.05
c. *Unit Cost (Log)* ON			
Closed Book CM	-.05	.09	.61
Open Book CM	-.13	.09	.17
Closed Book Team	-.23	.09	.01
Open Book Team	-.18	.10	.06
Facility size (Log)	-.10	.04	.01
Public owner	.15	.04	.00
d. *Delivery Speed (Log)* ON			
Closed Book CM	.07	.06	.23
Open Book CM	.14	.06	.01
Closed Book Team	.33	.06	.00
Open Book Team	.28	.06	.00
Facility size (Log)	.81	.03	.00
Public owner	-.07	.03	.01
e. *Construction Speed (Log)* ON			
Closed Book CM	.02	.05	.71
Open Book CM	.08	.06	.20
Closed Book Team	.17	.06	.00
Open Book Team	.10	.05	.07
Facility size (Log)	.91	.02	.00
Public owner	-.11	.03	.00

Figure A-2: Standardized structural equation model results.

There were several significant paths in this model that suggest how project delivery strategies, both directly and indirectly, influence project success. First, group cohesiveness was the only significant predictor of project cost growth (p=.00), when controlling for project delivery strategy, team integration, owner type and facility size. Improving the group cohesiveness by one unit reduced the average cost growth by 2.3%; although the overall variation explained was low (R^2=.11). Secondly, group cohesiveness was also a significant predictor of turnover experience and overall facility system quality. For a one unit increase in group cohesiveness, the turnover experience was improved by .58 units (p=.00) and the overall facility system quality was improved by .55 units (p=.00). Lastly, team integration was the only significant predictor of schedule growth (p=.01), when controlling for project delivery strategy, group cohesiveness, owner type and facility size. An increase of one unit in team integration reduced the mean schedule growth by 4.4%; although the overall variation explained was low (R^2=.13). Within the body of the *Owner's Guide*, these finding have been interpreted by the research team and translated into actionable steps for maximizing the likelihood of project success.

Limitations

There are several notable limitations that readers should understand when using this guide. First, the structural equation model explained roughly 40% of variation in team integration. The remaining variance could be attributed to a variety of sources, such as the capabilities of the owner's project manager or policies within the owner's organization that are independent of project delivery strategy. Similarly, the unexplained variance in group cohesion could result from differences in personality, company culture or prior experience. There is clearly a great deal of further study regarding effective teams in construction, but this research is an essential first step in demonstrating that relationships with project performance exist and can be measured. Secondly, comparisons across facility type were not conducted. Due to limitations in the sample size, sufficient comparative samples by facility were not large enough to allow for potential explanatory value. The paths identified within the structural equation model were across all sectors of industry, but may be stronger or weaker for specific facility types.

Importance of Analytical Methods

It is important for the reader to keep several items in mind, following the review of this section. Understanding the key elements of the methodology is important in the understanding of the research results. Several steps were included throughout the methodology to limit bias, including capturing evaluation responses directly from project owners to produce meaningful comparisons. The latent class analysis allowed us to understand not only how one variable, such as delivery method, impacted project outcomes—it allowed us to understand how several variables worked in concert to create typical profiles of projects which led stronger relationships to project performance.

Appendix B: Project Delivery Strategy Workshop

Overview

This document contains forms to support a process for a project delivery strategy selection workshop. Following the guidance in this document, the workshop should take between 2-4 hours. The primary objectives of this process are to:

- Provide a structured approach to assist owners in selecting an appropriate project delivery strategy;
- Enhance the use of integrated practices and team cohesion in all project delivery strategies; and
- Provide documentation of the selection decision.

Background

The project delivery strategy workshop process is based on the results of more than 200 U.S. building projects completed between 2008 and 2013. The research was conducted by the University of Colorado and the Pennsylvania State University with funding from the Pankow Foundation and the Construction Industry Institute. The complete Guide and details for the research can be found at http://bim.psu.edu/delivery.

Workshop and Facilitation

The selection of a project delivery strategy is best made in a workshop setting with the owner and key project stakeholders. This process will enhance the owner's understanding of the decisions needed to structure an effective project team and build alignment with the goals of the project from the beginning. Facilitation of the workshop will make the process more efficient. In addition to a solid understanding of the decisions within delivery strategies (i.e., organizational structure, contract payment terms and team assembly processes), a facilitator need only be familiar with the *Maximizing Success in Integrated Projects: An Owner's Guide* and the forms contained in this packet. Facilitation helps to answer questions, makes sure the process stays on track and keeps the workshop participants moving towards a formal selection.

Timing and Participation

Selection of the project delivery strategy should occur as early as possible, ideally during the programming and/or conceptual design phases. Key participants may include, but are not limited to the owner, facility manager, user representative, owner's construction representative and/or other key design and construction professionals depending upon how the owner is structured. Participation of a minimum 3-5 people and a maximum of 12-15 is recommended, but this number varies depending upon the project size/complexity and owner profile.

Potential Bias

The best approach is for workshop participants to keep an open mind about the delivery strategy. Preconceived ideas can introduce bias into the discussions. If participants have a bias towards a potential method, it is best to discuss it with the entire selection team at the beginning of the workshop. Putting ideas on the table helps others to understand the potential advantages of the different strategy approaches available.

Workshop Preparation

Pre-workshop planning will result in a more concise and informative session. It is helpful for the owner and facilitator to complete all known project information, goals and constraints prior to the workshop. The best approach is to complete the *Project Attributes* and the *Project-Specific Goals* and provide them to the workshop participants before conducting the workshop. However, these worksheets can be completed in the workshop if desired.

Workshop Process and Worksheets

For each step of the project delivery strategy selection process outlined in the *Owner's Guide*, a form or worksheet is provided to guide participants. Brief descriptions of these forms are provided on the following page.

Process Step	Form Name
Step 1: Define the Project Needs	
a. Document project summary information	**Form 1a) Project Description**
b. Determine project-specific goals	**Form 1b) Project-Specific Goals**
Step 2: Explore the Delivery Strategy Options	
Discuss organizational structure:	
a. Design responsibility	**Form 2a) Design Responsibility Opportunities/Obstacles**
b. Timing of involvement	**Form 2b) Timing of Involvement Opportunities/Obstacles**
Discuss contract payment terms:	
c. Cost transparency	**Form 2c) Cost Transparency Opportunities/Obstacles**
Discuss team assembly:	
d. Selection process	**Form 2d) Selection Process Opportunities/Obstacles**
e. Selection criteria	**Form 2e) Selection Criteria Opportunities/Obstacles**
f. Prior experience with owner	**Form 2f) Prior Experience Opportunities/Obstacles**
g. Interview process	**Form 2g) Interview Process Opportunities/Obstacles**
Step 3: Select the Project Delivery Strategy	
a. Identify legal and policy constraints	**Form 3a) Project Constraints**
b. Compare delivery decisions to known strategies	**Form 3b) Delivery Strategy Comparison**
c. Reflect on consistency of strategy	**Form 3c) Reflection Notes**
d. Summarize project delivery strategy decisions	**Form 3d) Executive Summary of Project Delivery Strategy**
Supplements a)-h)	
Supplements a)-g)	**Opportunities/Obstacles Checklists**
Supplements h)	**Integrated Practices and Cohesion Enhancements**

NOTE: Typically, the entire selection process can be completed by the project team in a 2-4 hour workshop session, as long as each team member has individually reviewed the project description and given consideration to goals prior to the workshop.

Workshop Attendance

Document the date, location, facilitator and attendees. This form is intended for administrative purposes only.

Step 1: Define the Project Needs

1a) Project Description

Provide information on the project. This includes attributes such as size, type, funding, risks, complexities, etc. All known information should be listed for the specific project, but the information should be concise.

1b) Project-Specific Goals

A precise determination of the project goals is an instrumental first step of the process that will guide the selection of the appropriate project delivery strategy.

Step 2: Explore the Delivery Strategy Options

2a)-g) Opportunities/Obstacles

These eight forms are used to summarize the assessments made by the workshop team of the specific opportunities and obstacles associated with the organizational structure, contract payment term factors and the team assembly process. At the end of each form, the workshop team documents the preferred option for each factor. The ratings are then transferred to the ***Initial Delivery Strategy Preferences*** form at the end of this section. When filled out, the ***Initial Delivery Strategy Preferences*** form should provide a summary of the initial decisions needed to compare project delivery strategies.

Supplements a)-g) Opportunities/Obstacles Checklists

These eight checklists provide the workshop team with additional guidance concerning general opportunities and obstacles associated with the organizational structure, contract payment term factors and the team assembly process. The list of opportunities and obstacles should only be referenced *after* the workshop team has exhausted ideas about the specific project on the ***Opportunities/Obstacles*** worksheets in Step 2a-g.

Step 3: Select the Project Delivery Strategy

3a) Project Constraints

Review any organizational policy or legal constraints on the delivery process. These constraints can limit, or even eliminate, the consideration of certain project delivery strategies. The workshop team should identify constraints using the form to narrow the potential choices, often to less than three viable strategies. The viable strategies are then carried forward to the ***Delivery Strategy Comparison*** worksheet, where they are compared against the workshop team's preferred options from ***Initial Delivery Strategy Preferences*** form in Step 2.

3b) Delivery Strategy Comparison

This worksheet allows for comparison of the viable project delivery strategies (identified in Step 3a) against the workshop team's preferred delivery options (***Initial Delivery Strategy Preferences***

summarized in Step 2). After completing this comparison, the workshop team will have identified the decisions needed for the desired delivery strategy for the project.

3c) Examine the Consistency of Delivery Strategy

The workshop team should hold a discussion on the consistency of the desired project delivery strategy. This discussion is an opportunity to examine the alignment between the workshop team's preferred delivery options, the known classes of project delivery strategies and critical success factors for the project team. The workshop team identifies any incompatibilities with their preferred delivery options and documents how their desired strategy will best support the project goals. Lastly, the workshop team lists specific examples of integrated practices and opportunities to build group cohesion that will be used to enhance the project team.

Supplement h) Integration and Cohesion Enhancements Checklist

These two checklists provide the workshop team with additional guidance concerning the enhancement of integrated practices and group cohesion. The list of enhancements relates to the Class I-V project delivery strategies discovered in the research. The checklists are meant to help owners achieve the optimal use of integrated practices and group cohesion in all project delivery strategies.

3d) Executive Summary of Project Delivery Strategy

This form summarizes all of the steps and documents the final project delivery strategy. This form functions as the executive summary for the project delivery strategy report. It should be attached as the first page of the report, with other forms attached behind it in the order in which they were completed.

Workshop Attendance

Workshop Summary	
Project Name:	
Workshop Date:	
Workshop Location:	
Facilitator:	

Workshop Participants	
Name	**Email**

Step 1: Define the Project Needs

Form 1a) Describe the Project

The following attributes should be considered in describing the specific project. Relevant documents can be added as appendices to the final summary report.

Project Description
Project Name:
Location:
Estimated Budget (or range):
Estimated Project Delivery Period:
Estimated Size (or range, in square feet):
Required Delivery Date (if applicable):
Source(s) of Project Funding:
Function Project Scope (i.e., what will be delivered):
Major Schedule Milestones:
Major Project Stakeholders:
Main Identified Sources of Risk:
Potential Safety Issues:
Sustainable Design and Construction Requirements:
Key Specialty Trades:

Form 1b) Set Project Goals

An understanding of project goals is essential to selecting an appropriate project delivery strategy and ultimately to defining project success. Therefore, project goals should be the first step in the project delivery strategy selection process. Typically, the project goals can be defined in three to five items that deal with project management and project success. Note that these goals should remain consistent over the life of the project.

Project-Specific Goals
Goal #1:
Goal #2:
Goal #3:
Goal #4:
Goal #5:

Step 2: Explore the Delivery Strategy Options

Form 2a) Design Responsibility - Opportunities/Obstacles

When considering how to structure design and construction services, owners have two primary choices. They can choose to hire a designer and primary builder separately (i.e., multiple contracts), using design-bid-build or construction manager at risk arrangements, or they can choose a combined solution (i.e., single contract) with design-build or IPD.

Multiple Contracts: Design and construction responsibility can be split into separate contracts. Design-bid-build contract forms have a clear separation with the builder's contract beginning after design is complete. Construction manager at risk forms of contract have separable preconstruction and construction contracts for the builder.	
Opportunities	**Obstacles**
Single Contract: Design and construction responsibilities can be combined into one contract. Design-build contracts have one contract between the owner and the design-builder. Integrated project delivery forms of contracts use multiparty agreements between the owner, designer, builder and specialty contractors.	
Opportunities	**Obstacles**
Preferred Option: Based on discussion of the opportunities/obstacles identified above, enter your preferred contract arrangement into Box 2a.	**Box 2a**

Form 2b) Timing of Involvement - Opportunities/Obstacles

Organizationally, timing of involvement relates to when the primary builder and other key specialty contractors are contracted. The research found three main timeframes for involvement: (1) prior to schematic design; (2) between schematic design and construction documents; and (3) following completion of construction documents.

Following Construction Documents: The primary builder is hired once the construction documents phase of design is complete or near completion. This allows a complete bid package to be used for bids if desired. Total cost of construction is typically a requirement in soliciting bids for the project. This timing is most common with design-bid-build delivery.

Opportunities	Obstacles

Between Schematic Design and Construction Documents: The primary builder is hired after ~30% of the design is complete, but before design is 100% complete. This method allows for the primary builder to be involved during the detailed design stages to provide construction input/constructability reviews. However, obtaining a total construction cost from bids can be more difficult as design is not complete when the builder is hired. Procurement typically involves technical and qualification factors in addition to cost. This timing is most common for the construction manager in construction manager at risk deliveries, and for specialty contractors in both construction manager at risk and design-build.

Opportunities	Obstacles

Prior to Schematic Design: The primary builder is hired when no more than 30% of the design is complete. This method allows for the earliest project involvement of the builder for pre-construction and construction management services during the design process. Procurement of builders at this stage commonly relies on qualifications-based selection but may also include cost factors. The timing functions with design-build, construction manager at risk and IPD.

Opportunities	Obstacles

Preferred Option: Based on discussion of the opportunities/obstacles identified above, enter your preferred timing of involvement for the primary builder and key specialty trades into Box 2b.	**Box 2b** *Primary Builder* *Key Specialty Trades*

Form 2c) Cost Transparency- Opportunities/Obstacles

Cost transparency refers to the use of either closed-book or open-book payment terms between the primary builder and the owner. It may also refer to the payment terms between primary builder and key specialty trades.

Closed Book: Closed-book accounting does not allow the owner or the team members to access one another's financial information associated with the project. Lump sum contracts are typically scoped for the total construction costs and a schedule of values is used to manage payment of work performed.	
Opportunities	**Obstacles**

Open Book: Open book accounting allows for the owner and core team members to participate actively in the cost estimation and project budgeting. The team members allow access to each other's financial information related to the project. Payment is based upon completed work in place plus a fee.	
Opportunities	**Obstacles**

Preferred Option: Based on discussion of the opportunities/obstacles identified above, enter your preferred contract payment terms for the primary builder and key specialty trades into Box 2c.	**Box 2c** *Primary Builder* *Key Specialty Trades*

Form 2d) Selection Process - Opportunities/Obstacles

Owners have the option to solicit bids or proposals for "any and all" builders interested in the project or to pre-qualify builders who then are the only organizations that are allowed to submit a bid/proposal for the project.

Open Procurement: For open procurement, owners typically invite any and all builders to submit a proposal or bid for a project. The project is open to all builders and specialty trades that are appropriately licensed and have adequate bonding capacity for the scope of the project.	
Opportunities	**Obstacles**

Shortlist: The use of shortlist allows the owner to prequalify firms based on financial stability, safety performance, prior project experience, or any other important factors required before the primary procurement process takes place. Shortlisting firms means fewer full proposals to review and the potential that all bidding firms are minimally qualified for the project.	
Opportunities	**Obstacles**
Preferred Option: Based on discussion of the opportunities/obstacles identified above, enter your preferred approach to selection process for the primary builder and key specialty trades into Box 2d.	**Box 2d** *Primary Builder* *Key Specialty Trades*

Form 2e) Selection Criteria - Opportunities/Obstacles

Once the decision to begin the procurement phase is made, the owner needs to develop the basis (or criteria) for selecting the builder, and potentially specialty trades, for the project. The owner has the choice to select based solely on price, based solely on qualifications, or to use Best Value to combine price and non-prices factors.

Price Only: The owner procures the builder, and potentially specialty trades, based on the price provided in the received bids. The bid that is fully responsive and has the lowest price is typically chosen as the builder for the project. No technical or qualifications factors are considered in the selection.	
Opportunities	**Obstacles**
Best Value: The owner procures the primary builder, and potentially specialty trades, using price as well as non-price factors such as time, quality, value-added design, qualifications or other project-specific factors.	
Opportunities	**Obstacles**
Qualifications-Based Selection: The owner procures the primary builder, and potentially specialty trades, using exclusively non-price factors such as time, quality, value-added design, qualifications and other project-specific factors. Price of the work is not considered in the selection.	
Opportunities	**Obstacles**
Preferred Option: Based on discussion of the opportunities/obstacles identified above, enter your preferred selection process for the primary builder and key specialty trades into Box 2e.	**Box 2e** *Primary Builder* *Key Specialty Trades*

Form 2f) Prior Experience with Owner - Opportunities/Obstacles

When constructing a project, the owner procures a builder based on the criteria important to the project. The selected construction firm can be one that the owner has never worked with or a builder with whom the owner has experience working with on previous projects.

First Time Working Relationship: First time working relationship implies that the owner can select a builder with whom they have no prior experience. The relationship is new and there will be a learning curve at the beginning of the project on how the owner and builder will work together but may expose the owner to new potential ideas or approaches.	
Opportunities	**Obstacles**
Previous Working Relationship: Previous working relationships occur when the owner selects a builder that they are familiar with from previously projects. There may be a reduced learning curve and an understanding of the relationship that already exists between the owner and builder.	
Opportunities	**Obstacles**
Preferred Option: Based on discussion of the opportunities/obstacles identified above, enter your preferred working relationship with the primary builder into Box 2f.	**Box 2f**

Form 2g) Interview Process - Opportunities/Obstacles

The use of an interview process when selecting a builder means that the owner is utilizing non-price factors in the procurement process. Interviews can range in intensity from simple clarifications of proposals to in-depth questions about scenarios that may be encountered during design and construction of the project. Owners need to choose prior to soliciting proposals or bids if interviews will be used.

No Interview Prior to Selection: If price only factors are used to select a builder or specialty contractor, then the owner most likely will not need to interview the potential construction firms. Not using interviews can shorten the procurement time as well as puts less burden on the owner to carry out additional steps in the procurement process.	
Opportunities	**Obstacles**

Interview Prior to Selection: When non-price selection criteria are used to procure a builder or specialty contractors, the owner can choose to use interviews. Depending on the complexity of the project and the non-price factors used in the RFP, owners will typically conduct interviews with 3-5 potential construction firms in order to clarify the proposals as well as inquire about specific scenarios for the project and overall attributes of the construction firm.	
Opportunities	**Obstacles**
Preferred Option: Based on discussion of the opportunities/obstacles identified above, enter your preferred stance on conducting interviews of the primary builder, prior to selection, into Box 2g.	**Box 2g**

Summarize Initial Delivery Strategy Preferences

Transfer your preferred delivery preferences (Boxes 2a-g) into the table below. This table represents a summary of initial decisions comprising a potential project delivery strategy. In Step 3, this form will assist you in selecting an optimal strategy for your project goals that is compatible with your organization's existing delivery policies and constraints.

Initial Delivery Strategy Preferences	
Selection Factors	**Preferred Option**
Box 2a. Design Responsibility	
Box 2b. Timing of Involvement	*(Primary Builder)* *(Key Specialty Trades)*
Box 2c. Cost Transparency	
Box 2d. Selection Process	*(Primary Builder)* *(Key Specialty Trades)*
Box 2e. Selection Criteria	*(Primary Builder)* *(Key Specialty Trades)*
Box 2f. Prior Experience with Owner	
Box 2g. Interview Process	

Step 3: Select the Project Delivery Strategy

Form 3a) Identify Delivery Constraints

Identify the most appropriate project delivery strategies that can accommodate your organization's policies on organizational structure, contract payment terms and team assembly processes. The terms "required" and "prohibited" represent constraints dictated by law or company policy. Review the list of constraints below and check each constraint that applies to your organization or project. For each constraint, a rating is provided for the appropriateness of each project delivery strategy. If an "X" appears under any project delivery strategy, you should discontinue evaluation of that strategy, as it is not compatible with your project constraints.

If multiple constraints are checked, then only note the strategies that are appropriate for *all* of the applicable (checked) constraints. For example, if the "owner is prohibited from using a single contract" (I, II, III are Appropriate, IV has a Fatal Flaw and V is Challenging if Selected) and "Early GC, CM or DB involvement is prohibited" (I, II are Appropriate, III is Challenging if Selected and IV, V have a Fatal Flaw), then the most appropriate delivery strategies for your project are I and II.

Project Constraints	Project Delivery Strategy Rating				
	I	II	III	IV	V
2a. Design Responsibility					
☐ Owner has a long history of using traditional delivery methods	++	+	+	–	–
☐ Owner is prohibited from using a single contract	+	+	+	X	–
2b. Timing of Involvement					
☐ Early GC, CM or DB involvement is prohibited	+	+	–	X	X
☐ Early trade involvement is prohibited	+	+	+	X	X
☐ Early GC, CM or DB involvement is required	X	X	+	+	+
☐ Early trade involvement is required	X	X	–	+	++
2c. Cost Transparency					
☐ Owner staffing cannot participate in monthly cost audits	++	+	X	+	–
☐ Closed book contract for GC, CM, or DB is required	++	+	X	+	X
☐ Open book contract for GC, CM or DB is required	X	–	++	–	+
2d. Selection Process					
☐ Prequalification of GC, CM or DB is prohibited	++	–	–	X	X
☐ Prequalification of trades is prohibited	++	–	–	X	X
☐ Prequalification of GC, CM or DB is required	X	+	+	++	+
☐ Prequalification of trades is required	–	+	+	++	+
2e. Selection Criteria					
☐ Selection of GC, CM or DB must be based solely on the cost of work	++	+	X	X	X
☐ Selection of trades must be based solely on the cost of work	++	+	+	–	X
☐ Selection of GC, CM or DB must be a competitive, best value decision	–	+	+	++	X
☐ Selection of trades must be a competitive, best value decision	–	+	+	++	X
☐ Qualification-based selection of GC, CM or DB is prohibited	++	+	–	+	X
☐ Qualification-based selection of trades is prohibited	++	+	+	+	–
2f. Prior Experience with Owner					
☐ Owner must procure GC, CM or DB from a list of approved partners	–	–	+	+	++
2g. Interview Process					
☐ Interviewing the GC, CM or DB is prohibited	++	+	X	X	X
☐ Interviewing the GC, CM or DB is required	X	–	+	+	++

Rating Key			
++	Most Appropriate	–	Challenging if Selected
+	Appropriate	X	Fatal Flaw (Discontinue evaluation of this delivery strategy)

Form 3b) Select the Optimal Project Delivery Strategy

In the form below, scratch out or cover the columns with project delivery strategies that were not-viable given the constraint analysis in Step 3a. Compare the workshop team's project delivery preferences, from the *Initial Delivery Strategy Preferences* form, to the remaining columns. Identify the single project delivery strategy, or two strategies, that most closely align with your preferences.

Delivery Options	**Class of Project Delivery Strategy**				
	I	**II**	**III**	**IV**	**V**
Box 2a. Design Responsibility	Separate	Separate	Separate	Combined	Separate; **Combined**
Box 2b. Timing of Involvement					
Primary Builder	CD or later	DD or CD; **CD or later**	Pre-SD	Pre-SD	Pre-SD
Key Specialty Trades	CD or later	DD or CD; **CD or later**	DD or CD; **CD or later**	**Pre-SD;** DD or CD	Pre-SD
Box 2c. Cost Transparency	Closed book	**Closed book;** Open book	Open book	**Closed book**	Closed book, **Open book**
Box 2d. Selection Process					
Primary Builder	Open	Shortlist	Open; **Shortlist**	Shortlist	Shortlist
Key Specialty Trades	Open	Shortlist	Shortlist	Shortlist	Open; **Shortlist**
Box 2e. Selection Criteria					
Primary Builder	**Price only**; Best value	Best value	Best value; **QBS**	Best value	QBS
Key Specialty Trades	Price only	Price only; **Best value**	Price only; **Best value**	Best value	QBS
Box 2f. Prior Experience with Owner	First time	First time	Repeat	First time; **Repeat**	Repeat
Box 2g. Interview Process	No interview	No interview	Interview	Interview	Interview

Abbreviations: SD=Schematic Design; DD=Design Development; CD=Construction Documents; QBS=Qualifications-Based Selection

Form 3c) Examine the Consistency of Delivery Strategy

In order to finalize the decisions for your project delivery strategy, use the form below to hold a discussion that examines the consistency of the workshop team's delivery preferences. When comparing the workshop team's delivery preferences against known project delivery strategies, the team's preferences may not align exactly with a single strategy. The purpose of this step is to identify those preferences that may be incompatible with a coherent strategy, as well as ensuring that the desired delivery strategy supports the project-specific goals. When trying to finalize a delivery strategy, the owner and their stakeholders should lean towards decisions that support the three themes found in the most successful delivery strategies—early involvement of team members, transparent cost accounting and qualification-based selection. Lastly, the workshop team should document specific examples of integrated practices and opportunities to build group cohesion that will be used to enhance the project team. Supplement h) provides a checklist of specific examples of integrated practices and cohesion considerations to start the discussion. However, the workshop team is encouraged to find other ways of supporting these critical success factors.

Project Delivery Strategy Selection Notes	
Which project delivery strategy, or strategies, were most similar to the workshop team's delivery preferences?	
List any delivery preferences that did not agree with the delivery strategy.	
Are the delivery preferences listed above compatible, i.e. do they generally conform with a known strategy? If not, can the workshop team agree to change one or more decisions to design a more consistent delivery strategy?	
Re-examine the project goals. How will the final project delivery strategy support the project goals?	
Identify specific examples for enhancing the project team (see Supplement h for additional ideas).	
Actions to improve participation in integrated practices: *1.*	*Actions to build group cohesion:* *1.*

Form 3d) Summarize Your Project Delivery Strategy

In the form below, summarize all of the steps and document the final project delivery strategy. This form will function as the executive summary for the report. It should be attached as the first page of the report with other forms attached behind it in the order in which they were completed.

Project Delivery Strategy Summary	
Project Description	
Project Name	
Estimated Budget	
Estimated Schedule	
Project Goals	
1a. Project-Specific Goals	1.
Project Delivery Strategy	
2a. Design Responsibility	
2b. Timing of Involvement	
2c. Cost Transparency	
2d. Selection Process	
2e. Selection Criteria	
2f. Prior Experience with Owner	
2g. Interview Process	
Project Constraints	
Project Constraints	1.
Enhancements to Integrated Practices and Team Cohesion	
Actions to improve participation in integrated practices	
Actions to build team cohesion	
General Notes	

Supplement a)-h) Opportunities/Obstacles Checklists

a) Design Responsibility Opportunities and Obstacles Checklist

MULTIPLE CONTRACTS (DBB or CM at-Risk)	
Opportunities	**Obstacles**
☐ Legal processes are well understood by the industry ☐ Separate procurement processes can simplify each parties selection ☐ If design is not well defined, it allows time for concepts to develop before the builder is engaged	☐ Linear design and construction process is inherent; fast-tracking requires aligned contract language with all parties ☐ Design changes can increase costs or drive adversarial relationships ☐ Errors in design lead to change orders and schedule delays
SINGLE CONTRACTS (DB or IPD)	
Opportunities	**Obstacles**
☐ Single point of responsibility for design and construction ☐ Higher level of design constructability ☐ Easier to align risk and reward with project goals ☐ Non-adversarial designer-builder relationship ☐ Designs can be more concise since the contractor is involved during design	☐ Early selection of team members can be challenging ☐ Scope must be well-defined early ☐ Selection is often constrained to performance based design and construction criteria ☐ Fewer checks and balances between design and cost

b) Timing of Involvement Opportunities and Obstacles Checklist

CONSTRUCTION DOCUMENTS OR LATER	
Opportunities	**Obstacles**
☐ Owner can finish design prior to beginning construction ☐ Allows for price to be known prior to beginning construction ☐ Procurement includes total construction cost that becomes the contract amount	☐ Constructability advice is costly to integrate into the design ☐ Greater potential for errors and omissions in the design documents ☐ Errors in design can lead to change orders and schedule delays
AFTER SCHEMATIC DESIGN AND BEFORE CONSTRUCTION DOCUMENTS	
Opportunities	**Obstacles**
☐ Base scope provides knowledge of construction methods during procurement ☐ Opportunity for team integration through constructability feedback and early modeling for shop drawings ☐ Potential reduction of changes and RFIs during construction ☐ Contractor input into the design ☐ More efficient procurement of long-lead items ☐ Ability to start construction before completing entire design ☐ Procurement can include price and non-price factors	☐ Constructability advice can cause design to incorporate rework ☐ Designers and builders may not have a pre-existing relationship ☐ Value engineering opportunities may be limited based on committed concepts ☐ Benefit of builder involvement during design can be limited if the designer and builder cannot work together effectively
BEFORE SCHEMATIC DESIGN	
Opportunities	**Obstacles**
☐ Constructability advice can be provided proactively with decision decisions ☐ Teams can design to the cost and schedule through timely input, rather than pricing what is designed ☐ Builder can assist the designer and owner in developing the project requirements and scope ☐ Potential reduction of changes and RFIs during construction ☐ Contractor input into the design ☐ More efficient procurement of long-lead items ☐ Ability to start construction before completing entire design	☐ Procuring the builder before the scope is fully understood limits the procurement options available to the owner ☐ Trade contractor involvement at this stage is new to many markets and finding qualified team members can be challenging ☐ Benefit of builder involvement during design can be limited if the designer and builder cannot work together effectively ☐ Construction costs are not fully known until late in the design phase

c) Cost Transparency Opportunities and Obstacles Checklist

CLOSED-BOOK ACCOUNTING (Lump Sum/Fixed Price)	
Opportunities	**Obstacles**
☐ Can require less owner effort to manage payment ☐ Is well understood in the construction industry ☐ Accounting is handled on an individual basis and is simpler to handle throughout the project	☐ Required builder to assume more risk and charge accordingly ☐ Can create adversarial relationships if disputes arise ☐ May be difficult for owners to understand what they are paying for beyond the schedule of values and checking physical progress ☐ Difficult to develop trust as the builder can hide issues in their finances and pay applications
OPEN-BOOK ACCOUNTING (Cost Plus/GMP)	
Opportunities	**Obstacles**
☐ Allows the owner to pay the true cost of the work plus the builder's fee ☐ Can provide owner with more cost knowledge for future projects ☐ Allows trust to be built through clear understanding of costs ☐ Fewer chances for disputes between owner and builder	☐ Requires more owner effort and administration in accounting and payment of the builder ☐Can provide disincentives to complete work at the lowest possible cost ☐ Without incentives, limits the builder's drive to save costs ☐ Potential for builders to utilize higher initial costs in order to realize savings later ☐ There is the possibility that costs could exceed the owner's budget substantially unless a GMP is implemented

d) Selection Criteria Opportunities and Obstacles Checklist

PRICE ONLY	
Opportunities	**Obstacles**
☐ Allows for simplicity in procurement ☐ Can allow a wider range of builders to bid for the work ☐ Can be the shortest procurement period ☐ Competitive bidding on price provides low initial construction costs based on a clearly defined scope of work	☐ Selecting the lowest price is not necessarily the best value for the project ☐ The absence of non-price factors could lead to selecting an unqualified builder ☐ Owner has to determine if the lowest bidding firm has included all components of the project to be fully responsive
PRICE AND/OR NON-PRICE FACTORS	
Opportunities	**Obstacles**
☐ Can allow for competitive and value-adding proposal elements ☐ Can serve to select team members with better project qualifications ☐ Allows for innovation by bidding builders to provide the best value proposal for the project ☐ Cost is not the only primary factor to evaluate proposals ☐ Suggests the hiring of a team member rather than purchasing of services ☐ Allows the team to focus on the "who" rather than "how much"	☐ Scoring of qualitative factors can be complex and requires more time and resources to develop ☐ May exclude builders who do not typically prepare qualifications/technical criteria ☐ Time required to define technical requirements and expectations through RFP development can be intensive ☐ Time required to evaluate proposals can be lengthy ☐ Increased cost to prepare proposals can limit the number of responsive firms ☐ Cost to prepare proposals can be substantial, which could increase bid amounts ☐ Can be challenging to demonstrate an objective selection ☐ More difficult to make a direct comparison between firms
NON-PRICE FACTORS ONLY	
Opportunities	**Obstacles**
☐ Hiring of a team member rather than purchasing of services ☐ Allows the team to focus on the "who" rather than "how much" ☐ Owner does not have to award to the lowest, responsive bidder ☐ Owner only has to evaluate qualifications and technical factors, no cost to consider	☐ Procurement does not include a cost portion in proposals

e) Selection Process Opportunities and Obstacles Checklist

OPEN PROCUREMENT	
Opportunities	**Obstacles**
☐ May allow for more builders in the market place to propose on a project, which could drive down initial costs ☐ Makes the selection process transparent	☐ Unqualified proposers may submit proposals and could be selected to construct the project ☐ An unmanageable number of proposers may submit bids
SHORTLIST	
Opportunities	**Obstacles**
☐ Allows the owner to select from only the best and most qualified proposing builders ☐ A smaller number of proposing builders may increase the effort by builders to provide innovative solutions in order to offer the best value to the project	☐ Two-step process can add time to the procurement process ☐ Qualitative elements can be complex to score

f) Prior Experience with Owner Opportunities and Obstacles Checklist

FIRST-TIME WORKING RELATIONSHIP	
Opportunities	**Obstacles**
☐ Can allow for a larger pool of builders to propose on a project ☐ May infuse new idea or construction techniques not seen from familiar builders ☐ Allows for the use of partnering/team building techniques to build a team relationship for the project	☐ Owner and builders will experience a learning curve for communication and working together ☐ There is the possibility that the owner and builder will have differing cultures that could conflict ☐ The level of trust between the owner and builder could be low during the initial stages of the project

PREVIOUS EXPERIENCE WORKING TOGETHER	
Opportunities	**Obstacles**
☐ Business processes will be known to each party ☐ Can include incentives to work together on future projects ☐ The established relationship lends itself to providing favors for one another ☐ A level of trust and collaboration already exists between the owner and builder	☐ Incentive for innovation from open competition may be diminished ☐ Owner may have legal or functional constraints ☐ Using the same builder does not mean the owner is receiving the best price or best value for the project

g) Interview Process Opportunities and Obstacles Checklist

NO USE OF INTERVIEWS	
Opportunities	**Obstacles**
☐ Not conducting interviews can shorten the procurement time ☐ Interviews may not provide a differentiator between proposing builders ☐ Potential to clarify proposals in a non-formal atmosphere	☐ May not have another opportunity for verbal clarifications of proposals ☐ May not have another chance to develop team chemistry ☐ Procurement based solely on the information provided in the received proposals

USE OF INTERVIEWS	
Opportunities	**Obstacles**
☐ Provides the opportunity to meet with potential key team members ☐ Increases the opportunity to examine qualifications in a face to face setting	☐ Additional time is required to organize and conduct interviews ☐ Need to determine method for ensuring interview process will lead to selection of optimal builder

Supplement h) Integration and Cohesion Enhancement Checklist

h) Integration and Cohesion Enhancement Checklist

CLASS I	
Integrated Practice Considerations	**Group Cohesion Considerations**
☐ Perform pull planning for construction activities ☐ Develop a BIM execution plan	☐ Review information sharing expectations
CLASS II	
Integrated Practice Considerations	**Group Cohesion Considerations**
☐ Co-locate the general contractor or construction manager with key specialty trades during construction phases	☐ Interview the general contractor or construction manager prior to selection ☐ Hold kick-off meeting when key trades join the project team to re-affirm project goals
CLASS III	
Integrated Practice Considerations	**Group Cohesion Considerations**
☐ Co-locate the general contractor or construction manager with the architect during design phases	☐ Interview key specialty trade prior to selection
CLASS IV	
Integrated Practice Considerations	**Group Cohesion Considerations**
☐ Invite each member of the core project team to participate in goal setting before starting design ☐ Co-locate the core project team during both design and construction phases	☐ Finalize and assemble the core project team before starting design ☐ Schedule time for team building activities that focus on personal interactions
CLASS V	
Integrated Practice Considerations	**Group Cohesion Considerations**
☐ Establish cross-functional teams within the core project team ☐ Perform pull planning for design activities	☐ Allow the core project team to select later trades ☐ Develop an on-boarding process for maintaining cohesion when new members join the team ☐ Focus on continuous improvement within the core project team