

5.0 Analysis 1: Alternative Project Delivery Method (MAE Requirement)

5.1 Background

An owner who is beginning a construction project must make one of the most important decisions of the entire project in the very beginning – what method the project is going to be designed and constructed by. This overall strategy includes delivery, procurement, and contracting methods which is broadly referred to as project delivery.

The decision has become more difficult in recent years as new hybrid delivery methods are being explored and more research is being conducted on traditional methods. In the past, the primary delivery method has been design-bid-build with a lump sum contract. Several newer methods, known as “alternative delivery methods” have gained popularity as proponents claim these methods improve the traditional method in terms of cost, time, project control and disputes.

5.2 Problem Statement

The current design-bid-build with early procurement project delivery method has resulted in 60 Construction Change Directives, 2,700 Request for Information, and 700 change orders to date. This has resulted in a cost escalation of approximately [REDACTED] to the original schedule. The change orders largely encompass 3 major areas: design omissions/errors, donor enhancements, and the incorporation of the latest and greatest medical equipment and technology in the design.

When Clark/Banks was bidding the project they were pricing the job off of GMP documents. These design documents were supposed to be sufficient to provide accurate pricing with reasonable allowances for detail items. The final construction documents were supposed to be delivered in April of 2007. However, the final construction set did not arrive until January 2009. This has also contributed to the change orders and delays.

5.3 Goal

Demonstrate that an alternative delivery method could have more effectively managed the changes while meeting the Owner’s goals.

5.4 Resources

Penn State University – Dr. Michael Horman

Penn State University – Dr. John Messner

KLMK Group, LLC – Curtin Skolnick

JHH Facility Management Group – Howard Reel

JHH Facility Management Group – Bob Singer

Clark Construction – Mike Hartman

Clark Construction – John Bond

Clark Construction – Brian Flegel

5.5 Analysis

Project Delivery and Contract Strategies Selection Tool

This analysis will use a software program developed by the Construction Industry Institute (CII) to determine which project delivery methods would work best. The top three delivery methods that prove to have the most potential will be analyzed in detail by superimposing them on the NCB project. Finally, a delivery method will be recommended as the best way the project should have been delivered. The recommended delivery method will be compared to the current method to determine what the advantages and disadvantages are.

The CII developed the Project Delivery and Contract Strategies (PDCS) selection tool as a way to quantitatively select a delivery method. The PDCS has 12 potential delivery method outcomes. Below is a list of the 12 possible delivery method outcomes with an explanation of each as explained by the CII.

1. Traditional Design-Bid-Build: Serial sequence of design and construction phases; procurement begins with construction; Owner contracts separately with designer and constructor.
2. Traditional with Early Procurement: Serial sequence of design and construction phases; procurement begins during design; Owner contracts separately with design, constructor, and supplier.
3. Traditional with Project Manager: Serial sequence of design and construction phases; procurement begins with construction; Owner contracts separately with designer and constructor; PM (Agent) assists Owner in managing project.
4. Traditional with Construction Manager: Serial sequence of design and construction phases; procurement begins with construction; Owner contracts separately with designer and constructor; CM (Agent) assists Owner in managing project.
5. Traditional with Early Procurement and CM: Serial sequence of design and construction phases; procurement begins during design; Owner contracts separately with designer and constructor; CM Agent assists Owner in managing project.
6. CM at Risk: Overlapped sequence of design and construction phases; procurement begins during design; Owner contracts separately with designer and CM @ RISK (constructor).
7. Design-Build or EPC: Overlapped sequence of design and construction phases; procurement begins during design; Owner contracts with Design-Build (or EPC) contractor.
8. Multiple Design-Build or EPC: Overlapped sequence of design and construction phases; procurement begins during design; Owner contracts with two Design-Build (or EPC) contractors, one for process and one for facilities.
9. Parallel Primes: Overlapped sequence of design and construction phases; procurement begins during design; Owner coordinates separate contracts with designer and multiple constructors (or D-B contractor(s)).
10. Traditional with Staged Development: Multi-stage, serial sequence of design and construction phases; separate contracts for each stage; procurement begins with construction; Project Manager (Agent) assists Owner with project management.

11. Turnkey: Overlapped sequence of design and construction phases; procurement begins during design; Owner contracts with Turnkey contractor.
12. Fast Track: Overlapped sequence of design and construction phases; procurement begins during design; Owner contracts separately with designer and constructor.

The delivery method is determined by 20 selection factors. These factors are based on 5 areas of project objectives; cost, schedule, safety, quality, and general objectives. Below is the list of 20 selection factors used by the PDCS.

1. Completion within original budget is critical to project success.
2. Minimal cost is critical to project success
3. Owner's cash flow for the project is constrained
4. Owner critically requires early (and reliable) cost figures, to facilitate financial planning and business decisions
5. Owner assumes minimal financial risk on the project
6. Completion within schedule is highly critical to project success
7. Early completion is critical to project success
8. Early procurement of long lead equipment and/or materials is critical to project success
9. An above normal level of changes is anticipated in the execution of the project
10. A below normal level of changes is anticipated in the execution of the project
11. Confidentiality of business/engineering details of the project is critical to project success
12. Local conditions at project site are favorable to project execution
13. Owner desires a high degree of control/influence over project execution
14. Owner desires a minimal level of control/influence over project execution
15. Owner desires a substantial use of its own resources in the execution of the project
16. Owner desires a minimal use of its own resources in the execution of the project
17. Project features are well defined at the award of the design and/or construction contract
18. Project features are not well defined at the award of the design and/or construction contract
19. Owner prefers minimal number of parties to be accountable for project performance
20. Project design/engineering or construction is complex, innovative or non-standard

For this analysis, the PDCS program will be used to determine the best delivery method based on the Owner's, A/E's, and CM's objectives (factors). By having goals from each team player, it will provide a perspective from each side of the fence. Principles of each entity were surveyed to determine what goals they felt were most important to the success of the project. The results will be compared to determine if there is a consensus on how to deliver the project.

Each principle was asked to select 6 factors from the list of 20 and put them in order of importance. The 6 factors are then weighted, 1-100% with 100% being the most important. The following are the results of the survey.

Owner's Factors

- 100% - Completion within schedule is highly critical to project success
- 100% - An above normal level of changes is anticipated in the execution of the project
- 95% - Completion within original budget is critical to project success
- 95% - Early completion is critical to project success
- 90% - Owner assumes minimal financial risk
- 50% - Early procurement of long lead equipment and/or materials is critical

CM's Factors

- 100% - Completion within original budget is critical to project success
- 98% - Completion within schedule is highly critical to project success
- 95% - Project features are not well defined at the award of the design and/or construction contract
- 85% - An above normal level of changes is anticipated in the execution of the project
- 75% - Owner critically requires early (and reliable) cost figures, to facilitate financial planning and business decisions.
- 60% - Early procurement of long lead equipment and/or materials is critical to project success

A/E's Factors

- 100% - Completion within original budget is critical to project success
- 100% - Completion within schedule is highly critical to project success
- 92% - An above normal level of changes is anticipated in the execution of the project
- 90% - Owner desires a high degree of control/influence over project execution
- 75% - Owner desires a substantial use of its own resources in the execution of the project
- 65% - Project features are not well defined at the award of the design and/or construction contract

The survey results show conclusive evidence that the project goals are shared by each party. Each party believes the project goals are broadly:

- On time
- On Schedule
- Above average number of changes
- Substantial control/oversight by Owner
- Not well defined features at award
- Early procurement is critical

The factors that were identified in the survey were analyzed by the PDCS. The top 2 delivery methods with their ratings are listed below.

Owner's PDCS Results

Turnkey – 81.13

Design-Build or EPC – 77.64

CM's PDCS Results

CM @ Risk – 68.05

Turnkey – 64.91

A/E's PDCS Results

Traditional Design-Bid-Build – 76.25

Traditional with Construction Manager – 74.52

The results are rather surprising considering each entity had more-or-less the same project objectives. The objectives' order of importance and weight were different in each case which resulted in a mix of project delivery methods.

The PDCS failed to take into account 3 major project constraints/objectives.

1. Project delivery familiarity in geographical region
2. Extensive user requirements from multiple tenants
3. High quality of construction

The familiarity of project delivery is a significant constraint when selecting a delivery method. For example, a Turnkey delivery method is not common in this geographical area or the commercial construction industry in general. Many of the potential bidders would hesitate to take on a project like this because the risk would be too great, especially because the construction industry was booming at the time of the contract award.

JHH has to coordinate with hundreds of end users who all have different requirements. Technology and equipment is constantly changing which means that the detail design will be held off as long as possible. JHH will require as much control as possible to be able to dictate last minute changes.

The quality of construction is significantly above average. Much of the project's financing comes from donors who have contributed millions of dollars. Some of the large donors have their own architects to ensure they are getting what they want. This requires a robust quality control and assurance program for all team players.

Based on the PDCS results, research, and industry interviews the top 3 delivery methods that offer the most potential to meet the project goals while managing the project changes efficiently are:

1. Integrated Project Delivery
2. Design-Build
3. Traditional with Early Procurement and Construction Manager

Integrated Project Delivery

The Integrated Project Delivery (IPD) method was not included in the PDCS analysis. This method is relatively new and is a critical industry issue in the current market.

Sutter Health System out of Sacramento, CA has used the delivery method with some promising results. On the Camino Medical Group Mountain View Medical Center (\$98 million), Sutter Health used the IPD. They believe the delivery method saved approximately \$9 million and 6 months over a traditional delivery method.

The working definition as defined by the American Institute of Architects (AIA) is:

“Integrated Project Delivery (IPD) is a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.”

Figure 11 below shows the relationship among all the team players.

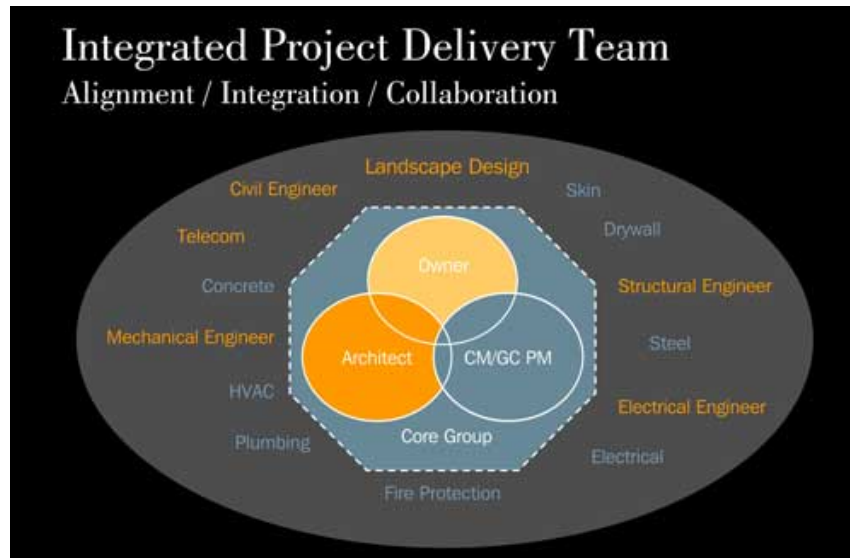


Figure 11: IPD Relationships Among Team Players

The backbone of the IPD method is to build a team with collaboration and trust. This fundamental idea encourages parties to focus on project outcomes rather than their own goals. Achieving the benefits of IPD requires that all project parties follow the Principles of Integrated Project Delivery as defined by AIA.

1. Mutual Respect and Trust – all team players understand the value of collaboration and are committed to working as a team in the best interests of the project.
2. Mutual Benefit and Reward – compensation is based on the value added by an organization and it rewards “what’s best for project” behavior, such as providing incentives tied to achieving project goals.
3. Collaborative Innovation and Decision Making – information is freely exchanged between all participants and judged on merit, not the author’s status.

4. Early Involvement of Key Participants – key participants are involved from the earliest practical moment. The combined knowledge and expertise is most powerful during the project’s early stages where informed decisions have the greatest effect.
5. Early Goal Definition – project goals are established early, agreed upon and respected by all participants.
6. Intensified Planning – recognizes that increased effort in planning results in increased efficiency and savings during execution.
7. Open Communication – team performance is based on open, direct, and honest communication among all participants. A no-blame culture is established and any disputes are recognized as they occur and promptly resolved.
8. Appropriate Technology – cutting edge technologies are used to maximize efficiency and accuracy.
9. Organization and Leadership – the project team is an organization in its own right and all team members are committed to the project team’s goals and values. Leadership is taken by the team member most capable with regard to specific work and services.

The IPD method offers many advantages and disadvantages over the current delivery method on the NCB project. These items are listed below.

Advantages

- Open communication lines between project participants would make it easier to incorporate changes immediately and openly evaluate their impact on cost, schedule and quality
- Better control of cost in design phase because contractor could provide accurate pricing
- Constructability issues can be addressed early in the design phase by the contractor
- The schedule could be reduced because the contractor could have been involved early in pre-construction planning and construction visualization using BIM
- Design omissions and errors could have been reduced with the use of BIM
- Disputes between team players could have been reduced because of the team culture and rewards
- A clearly defined scope of work could have been defined and understood by the contractor early on
- The project team would have a better understanding of the end users needs which would add value to the project
- Early involvement of specialty contractors could allow early fabrication and purchasing of long lead time items

Disadvantages

- Not a familiar delivery method in the region
- Contracts are not well developed for this type of delivery method which increases the risk
- Insurance liability risk associated with sharing BIM information among team members
- New delivery method that has not yet been “proven” in the industry – too risky for the largest hospital construction project in the country

Clearly, the IPD method attempts to correct many of the inefficiencies in the construction industry. The guiding principles of the method are extremely valuable. The NCB project could benefit enormously just from having the team approach instead of the individual approach.

However, it is not realistic to think that the Owner would want to use a delivery method that is unproven and unfamiliar to many of the companies they consistently work with. Even though the method sounds very promising, it is not appropriate to use the IPD on a project of this magnitude.

Design-Build

The design-build delivery method allows the owner to contract the design and construction aspects to a single entity known as a design-build contractor. The entity is usually a contractor who has established a joint-venture with a design firm or a contractor that has an in-house design expertise.

The delivery of the project is accelerated because construction is overlapped with design. The actual time it takes to complete design and construction is often not accelerated. Also, the risk is minimized for the owner because only one contract is held. Figure 12 below shows the contractual relationships among the team players.

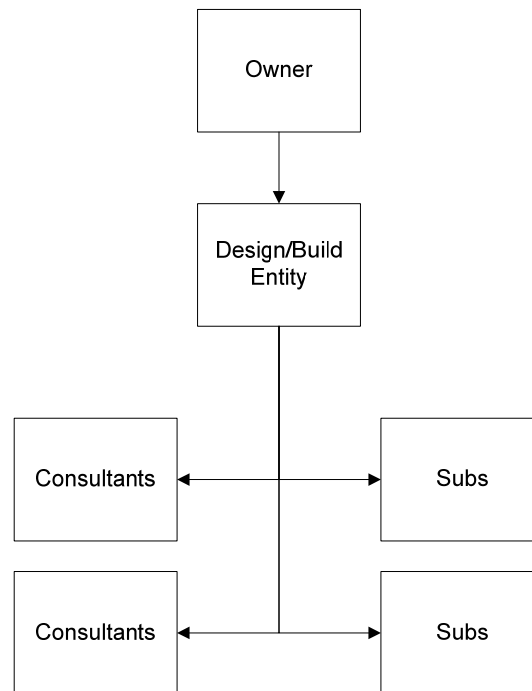


Figure 12: Design-Build Relationship Structure

The design-build delivery method offers many advantages and disadvantages over the current delivery method on the NCB project. These items are listed below.

Advantages

- Cost control could have been maximized early on because the design-builder would take responsibility for protecting the budget
- Open communication lines between project participants would make it easier to incorporate changes immediately and openly evaluate their impact on cost, schedule and quality
- Team approach
- Better control of cost in design phase because contractor could provide accurate pricing
- Constructability issues can be addressed early in the design phase by the contractor
- A clearly defined scope of work could have been defined and understood by the contractor early on
- Early involvement of specialty contractors could allow early fabrication and purchasing of long lead time items
- Quality control can be improved by recognizing problems early and working together to solve them
- Bidding time is reduced because redesign time is eliminated

Disadvantages

- Would not have accelerated the schedule because the current method is already fast tracked
- One single entity would not allow the Owner to have enough control over design and construction
- No checks and balance
- Not as flexible to changes
- Risk of sacrificing design quality to protect design-builder's profits
- Owner is responsible for quality assurance

The design-build approach has many of the same advantages as the IPD method. Specifically having the contractor involved from the beginning of the project to provide cost, schedule, and constructability analysis would have been very valuable for the NCB. This could have reduced the number of changes by identifying some of the issues that have caused problems in the field. Early procurement would have allowed the contractor time to find the best value source instead of trying to meet the schedule. This would have resulted in some cost savings.

The disadvantages of the delivery method make it unlikely choice for this project. JHH desires a lot of control over the design and the construction. Not having the check and balance system in place could jeopardize the quality of the project. This would have made it difficult to incorporate the large number of late changes in the project from donor enhancements.

Another approach to design-build is to use specialty contractors in a design-build capacity. On the NCB, most of the design omissions/errors and changes impacted the mechanical, electrical and plumbing (MEP) scope. Further research was conducted on the use of a design-build mechanical and electrical contractor.

The GMP drawings that the MEP subs used to bid the job changed drastically when they were finally completed. When the contract was awarded to the MEP contractors in January of 2007, they expected the final construction drawings would be complete in April of 2007. However, the design/owner team was unable to meet this deadline. Instead, they issued Construction Change Directives (CCD) that had design complete on 2 floors for each package. This continued until the design was finally complete in January 2009.

The MEP subs have estimated that the changes/CCDs have increased their contract value by 17%. The constantly changing design has severely impacted the coordination of the MEP system and the prefabrication of components. Last minute drawings were often delivered right before the schedule had them installing the area. This took the entire float out of the schedule and in some cases, pushed the schedule.

If a design-build mechanical and electrical contractor would have been used on this project, the initial cost would have increased by 5% according to the subcontractors. However, this would allow them to get involved early in the design (before construction started) to work with the mechanical engineer to provide value engineering, cost, and schedule input. This would have allowed them to get an early start on coordination, procurement of long lead items and prefabrication. Ultimately, the initial cost would have been saved because the number of changes could have been reduced dramatically.

Traditional with Early Procurement and Construction Manager

This delivery method is exactly the same as the current method, with the exception of having a construction/project manager contracted directly to the owner to provide construction expertise. Figure 13 below shows the contract relationships in this delivery method.

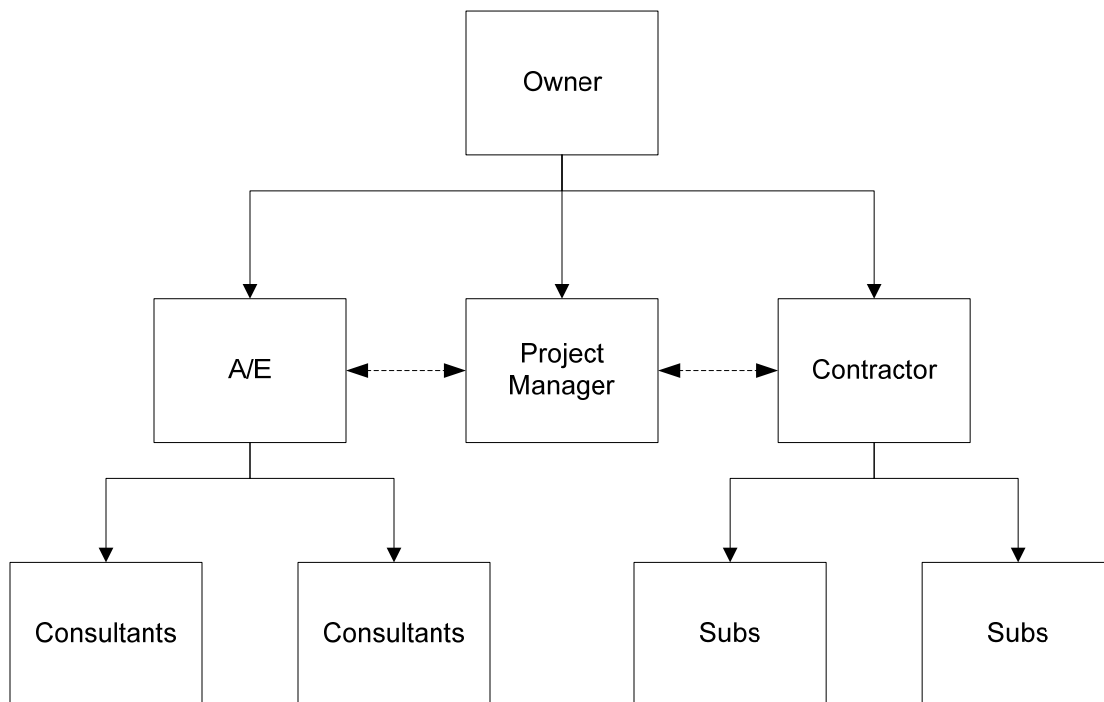


Figure 13: Traditional with Early Procurement and Construction Manager Relationship Structure

KLMK Group, a project management company that specializes in healthcare projects was contacted to determine the cost associated with having a project manager. They estimated on a project of this size, the initial cost is 1% of the total building cost. However, they believe the value added from their expertise will pay that cost back during the delivery of the project.

A project management company such as KLMK would provide a team of 3-4 people onsite during the planning, designing, and construction phases of the project. They would work with the project team to establish expectations, define the scope, set the budget and schedule, and help negotiate contracts during the bidding phase. They could also assist with regulatory agency approval and permitting for the facility.

The traditional with early procurement and construction manager delivery method offers many advantages and disadvantages over the current delivery method on the NCB project. These items are listed below.

Advantages

- PM has extensive experience with delivering similar projects
- PM is familiar with designers/contractors/consultants/subcontractors in the healthcare field
- Transparent approach to managing the project by sharing cost, schedule, quality, etc. information
- PM would provide a check and balance of contractor pricing for change orders
- Decreases the chances of disputes by promoting a team approach
- PM could assist the Owner with managing changes
- PM could manage the design process which has the potential to accelerate the design
- PM would assist with close-out and occupancy
- PM would assist with master planning of entire campus and the affects of the NCB

Disadvantages

- Initial cost
- May create hostile environment by challenging the contractor's expertise
- All participants must be cooperative and communicate well

The primary advantage of having a project manager on the team is the expertise they bring. Although, JHH has their own facility management group, they have not managed a project of this magnitude. The PM could provide significant value by managing the changes and reviewing the pricing. With the amount of changes on this project, it is likely there will be a dispute and a project manager could reduce the likelihood of that happening.

The obvious disadvantage is the extra cost associated with having another team member. If the Owner knew the project was going to have a lot of changes, then they could have assumed this method was a good investment.

5.6 Conclusion

The PDCS did not identify the most appropriate delivery method in the author's opinion. However, the process of working through the PDCS tool was helpful in identifying the team's objectives. These objectives were used to evaluate multiple alternative delivery methods.

The three delivery methods that were researched all had many advantages and disadvantages. The current delivery method was selected by JHH because they were familiar with it and thought it had the least amount of risk. The comparison of the alternative delivery methods showed that the current delivery method was an inefficient method.

Hindsight is often 20-20, but knowing how the project has played out thus far, an alternative delivery method would have been better suited. The recommended delivery method is a hybrid of all 3 methods researched. Since each method had their advantages and disadvantages, it was necessary to have a combination of each to have the perfect balance.

The recommended delivery method would have a relationship structure similar to the traditional with early procurement and construction manager. All project team players would have to buy into the principles outlined in the IPD method. A design-build mechanical and electrical contractor would be used.

This hybrid delivery method attempts to solve the biggest problems on the NCB project. The project manager would be involved early in planning and could help manage the changes. Their expertise would be very valuable when selecting team members and providing cost, schedule, and quality information. Their initial cost would certainly be paid back in value added to the project.

The ideas of IPD are very progressive for the industry. However, behind closed doors many principles will agree the industry needs to take this direction. By promoting collaboration, trust, communication, technology and a fair reward system the project team would work more efficiently with fewer disputes. This would reduce the number of changes.

A design-build mechanical and electrical contractor would certainly add value to the project. The delays in the MEP trades would have been reduced if their expertise would have been brought in at the beginning. The initial cost of having more personnel and resources for the MEP subs would have been offset by the reduction in changes and delays.