Project Delivery Methods

for the Transport Infrastructure

Kostas Tzanakakis

RAILHOW

“Project Delivery Methods
for the Transport Infrastructure”

Kostas Tzanakakis

Published by Kostas Tzanakakis

Abbreviations

CCM	Certified Construction Manager
CMAR	Construction Manager at Risk
CMa	Construction Manager as Adviser
CMR	Construction Manager at Risk
D&B	Design and Build
D-B-B	Design – Bid - Build
DBFM	Design-Build-Finance-Maintain
DBFO	Design-Build-Finance-Operate
DBM	Design-Build-Maintain
EPC	Engineer-Procure-Construct
GMP	Guaranteed Maximum Price
PPP	Public Private Partnership
RFP	Request for Proposal
RFQ	Request for Qualifications [1]
VE	Value Engineering

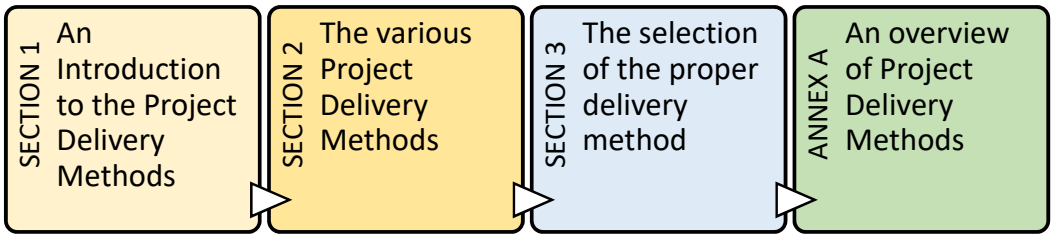
[1] also known as Pre-Qualification Questionnaire (PQQ) is a document often distributed before initiation of the RFP process.

Foreword

Governments are executing many projects – new infrastructure and maintenance of existing infrastructure.

There are various project delivery methods. What are best methods for delivering the projects? For new road/rail infrastructure may be the Design – Bid – Build or the Design and Build is more suitable. For new road infrastructure with toll stations or for the construction of Rest Areas may be a PPP scheme should be considered.

This study shall be **a guide for the selection of the best project delivery method** and is structured in three Sections and an Annex:



The project delivery methods examined here are:

Design-Bid-Build (D-B-B) – The traditional project delivery method, which customarily involves three sequential project phases: design, procurement, and construction (Section 2.1).

Design & Build (D&B) – A project delivery method that combines architectural and engineering design services with construction performance under one contract (Section 2.2).

Construction Management At Risk (CMAR) – A project delivery method in which the Construction Manager acts as a Consultant to the Owner in the development and design phases, but acts as a general contractor during construction (Section 2.3).

Construction Manager as Adviser (CMa) - A project delivery method in which the Construction Manager facilitates the contractor bidding and selection process, and provides a broad range of construction phase services (Section 2.4).

Public Private Partnership (PPP) - a delivery method whereby a Public Entity partners with a Private Entity for delivering public infrastructure (Section 2.5).

This study is based on references mentioned in Section4.

1 Project Delivery Methods – an Introduction

Project Delivery is a comprehensive process including **planning, design and construction** required to execute and complete any type of project. One of the most important decisions made by any Owner getting on a construction project is the choice of the project delivery method – how the project will be designed and constructed. There are many options for delivery methods and many variations within those options.

An Owner faced with choosing a project delivery method should consider several factors in making the decision, including:

(1) Project size
(2) Type of project
(3) Legislative and regulatory requirements
(4) Tolerance for risk
(5) Schedule
(6) Local market conditions
(7) Desired level of involvement
(8) Owner's resources and capabilities

When these factors are properly evaluated, a good decision can be made on the selection of a project delivery method that best fits the goals and requirements of the Owner and the project.

The use of a qualified Construction Manager can greatly help in developing a project and in making the decision on project delivery methods, regardless of whether this expertise comes from internal staff or from a third-party provider.

- In Section 3, a *Project Delivery Selection Matrix* and
- In ANNEX A, an *overview of project delivery methods*

is provided.

2 The various Project Delivery Methods

2.1 Design-Bid-Build (D-B-B)

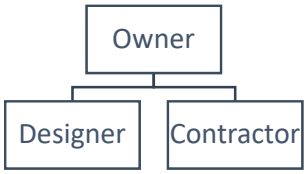


Figure 1: Design - Bid - Build

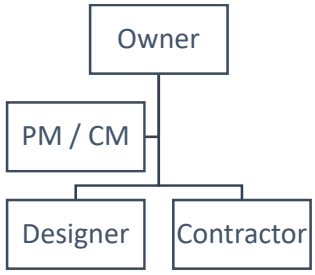


Figure 2: Design - Bid - Build with PM/CM

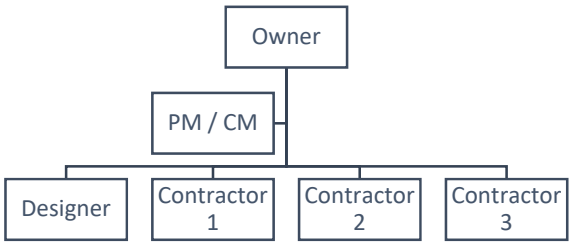


Figure 3: Multi Prime Contracting

2.1.1 Description

The Design-Bid-Build system remains the most frequently used delivery method for construction projects. Using this method, the Owner engages a Design Consultant to prepare the design of the project, including construction drawings, and specifications. The Design Consultant may also provide additional services including environmental investigation, permitting, right-of-way purchase documents, Stakeholder Management, and submissions for project funding.

Once completed the tender documents, tender is floated, so interested Contractors can prepare and submit their bids for the work. The Owner will select a Contractor, usually based on the lowest bid, or some hybrid of price and technical merit. The selected general Contractor will then execute contracts with sub-Contractors to construct various specialty items.

The awarded Contractor is responsible for constructing the project in accordance with the contract documents. The Design Consultant typically maintains limited oversight of the work and responds to questions about the design on behalf of the Owner.

If a Construction Manager is not involved in the process, the Design Consultant may also assist the Owner in administering the construction contract, including

determination of project progress, for validation of interim payments made to the general Contractor.

An important variation of Design-Bid-Build is **multiple prime contracting**, in which the Owner holds separate contracts with Contractors of various construction work disciplines, such as general construction, earthwork, structural, mechanical, and electrical. In this system, the Owner, or its Construction Manager, manages the overall schedule and budget.

2.1.2 Role of the Project Manager/Construction Manager (PM/CM)

In the past, most Owners relied on the experience of the Design Consultant to provide a complete and responsible set of contract documents. Recently, more and more Owners have found the value in utilizing the advice and expertise of those **with overall process, program and construction management knowledge during the design phase**.

The PM/CM should be engaged in the project as early as possible to guide and assist the Owner through all phases of delivering the project. The Construction Manager may also act as the Owner's representative with the other members of the project team, being the point of contact for the Design Consultant, Contractor, and any other specialty Consultants engaged in the project by the Owner.

In a Design-Bid-Build delivery method, in addition to overall management expertise, the PM/CM must also provide construction expertise and advice to the project team during all pre-construction phases.

In **the pre-design phase**, the PM/CM's development and evaluation of the project,

- defining the overall program and scope of work,
- development of project budgets and schedules,
- evaluation of project delivery methods,
- procurement of the Design Consultant, and
- development of project procedures and standards.

During the **design phase**, the PM/CM's role

- will continue to include tasks started in the pre-design phase,

  and may include

- oversight of the Design Consultant,
- review of design documents, generation of cost estimates,
- value engineering,
- budget and schedule management, and
- development of overall phasing and contracting approaches.

In the **procurement phase**, the PM/CM's role may include

- generation of bidder interest,
- pre- qualification of bidders (if used),
- management of bid document and addenda distribution,
- conducting the pre-bid meeting and bid opening, and production of executed contracts.

As a project shifts into **construction phase**, the PM/CM's role may include

- representing the Owner's interests through a system of project controls that include conducting periodic progress meetings,
- document control,
- cost tracking and management,
- evaluation of payment requests,
- Variation Order management,
- quality management,
- schedule control,
- monitoring of Contractor's safety efforts, commissioning and
- generation of the punch list[2].

During the **post-construction phase**, the PM/CM's role may include

- commissioning,
- coordination of occupancy procedures,
- the assembly and review of record documents and manuals,
- warranty management, and
- final project close-out.

2.1.3 Main characteristics

The Design-Bid-Build system's main characteristics:

a. Traditional delivery system
b. Owner contracts separately for design and construction services
c. Bid based on complete design and specifications
d. Owner retains high level of control and risk
e. Traditionally a unit priced contract

2.1.4 Applicability

a. Projects where the Owner needs to completely define the scope
b. Project scope can be best defined
c. Significant risks or third-party issues (ROW, utility, environmental) that can be best resolved or best managed by the Owner.

[2] A punch list is a document prepared near the end of a construction project listing work not conforming to contract specifications that the contractor must complete prior to final payment.

2.1.5 Risks

The D-B-B delivery method has been the standard delivery method for many years. This method gives the Owner reliable price information for the project before construction starts. With proper design oversight and budgeting of the total project, costs are somewhat predictable for the Owner once the bids are received.

In D-B-B, the Owner has more control over the design content, relative to other delivery methods.

Next, some risks are mentioned:

a. Initial low bid might not result in ultimate lowest cost or final best value
b. Higher level of inspection/testing needed by the Owner
c. Owner bears risk of design adequacy
d. Potential adversarial relationship among the contracting parties
e. Limited opportunity to incentivize Contractors to provide enhanced performance (cost, time, quality)

2.1.6 Advantages

a. Applicable to a wide range of projects
b. This method is widely applicable, well understood, and has well-established and clearly defined roles for the parties involved.
c. This method is the most common approach for public Owners having to comply with local, or state procurement acts.
d. Owner controls design and construction. The Owner has a significant amount of control over the end product, particularly since the project's features are fully determined and specified prior to selection of the Contractor.
e. Design changes can be easily accommodated prior to start of construction
f. Design is complete prior to construction award
g. Construction cost is fixed at contract award
h. Relative ease of implementation.

2.1.7 Disadvantages

a. Design and construction are sequential, typically resulting in longer time schedules
b. The Owner generally faces exposure to Contractor Variation Orders and claims over design and constructability issues since the Owner accepts liability for design in its contract with the Contractor.
c. This traditional approach, in some cases, may promote more antagonistic relationships rather than cooperation or coordination among the Contractor, the Design Consultant and the Owner.

d. If the Owner uses the fixed price bidding and compensation method, the Contractor may follow a least-cost approach to completing the project and the Owner may receive less scope or lesser quality than expected for the price, requiring increased oversight and quality review by the Owner.

   If the Owner uses the unit price bidding and compensation method, the Contractor may pursue an increased-scope approach to maximize revenue from the contract, while providing the Owner more scope than expected.

e. The absence of construction input into the project design may limit the effectiveness and constructability of the design. Important design decisions affecting both the types of materials specified and the means and methods of construction may be made without full consideration from a construction perspective.
f. Requires significant Owner expertise and resources.
g. Construction cost unknown until contract award.
h. No Contractor input in design, planning or value engineering (VE).

The disadvantages listed above assume that the Owner does not have experienced Certified Construction Managers (CCM) on staff, and has not retained the services of a CCM during the design phase of the project.

2.1.8 Possible Contracting and Procurement methods

Numerous variations in procurement exist when using the D-B-B method. The most common approach to bidding a project in vertical construction (a building or treatment facility) is for general Contractors to submit a sealed lump-sum or fixed price bid.

In most horizontal projects (such as transportation), the most common approach to bidding is unit price, line item bids, where quantities are easily measured during construction and the Owner pays only for what is installed.

When allowed by governing procurement policy, many Owners take some effort to pre-qualify Contractors, either through invitation or an objective set of criteria considering construction experience and financial capability. Pre-qualification helps assure the Owner that the Contractor is capable of performing the scope of work specific to the project at hand. Once the field of bidders is established, an Owner will require sealed bids, wherein the lowest bidder will earn the right to perform the work.

Some (mostly private) Owners prefer to negotiate bids with pre-selected General Contractors. This can be an especially powerful technique if the Owner considers qualifications, history of claims and experience in related work along with price in its evaluation.

What the Owner should really be seeking is **the best value for its money**, **not necessarily the lowest initial cost**. Through a careful negotiation and Contractor evaluation, the Owner can maintain the maximum amount of control over the resulting construction portion of the project.

2.2 Design & Build (D&B)

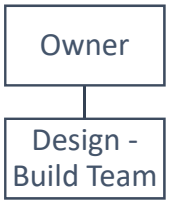


Figure 4: Design - Build

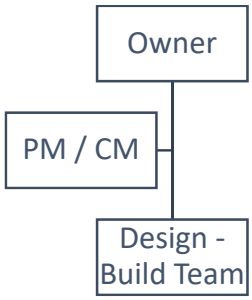


Figure 5: Design - Build with PM/CM

2.2.1 Description

The design-build (D&B) project delivery system has grown in popularity, and is seen as a solution for addressing the limitations of other methods. For an Owner, the primary benefit is the simplicity of having one party responsible for the design and construction of the project. While the other delivery systems often give rise to disputes among various project participants, with the Owner acting as referee (or party eventually to blame), in D&B many of these disputes become internal D&B team issues which may not affect the Owner.

Under this system, the Owner contracts with a D&B team, which can be

(1) a Joint Venture of a Contractor and a Design Consultant,

(2) a Contractor with a Design Consultant as a Sub-Consultant,

(3) a Design Consultant-led team with a Contractor as a subcontracted entity, or

(4) a single firm capable of performing both design and construction.

Since Contractors are most comfortable in the role of risking corporate capital in performing projects, they usually are the lead members of this sort of team.

At some point early in the process, through a prescribed process, the D&B team will establish a fixed price to complete the design and construction of the facility. Once underway, the D&B team is then responsible for construction of the project, and for all coordination between design and construction.

2.2.2 Role of the Project Manager/Construction Manager (PM/CM)

In D&B, the Design Consultant is part of the builder's team, rather than under direct contract with the Owner. There continues to be an important role for the Construction Manager. **This role is particularly critical if the Owner does not have experience with the D&B delivery method**.

Owners with time-consuming decision-making processes may find themselves particularly pressured in D&B, since the **speed of execution offered by this delivery method relies on the Owner's promptness and responsiveness**.

As in all delivery methods, **it is important to engage the Construction Manager as early in the project as possible** to guide and assist the Owner through all phases of project delivery. It is particularly important in Design & Build because **the program of requirements must be thoroughly analyzed and tightly documented**. The Contractor will finally deliver a project as per the requirements that are documented and that are the basis for his D&B proposal.

In a D&B environment, the Project Manager/Construction Manager will act as the Owner's representative with the rest of the project team, acting as the point of contact for the D&B team and any other specialty Consultants engaged in the project by the Owner.

The PM/CM's role in a Design & Build delivery method

- begins early in the project, assisting with the development of the Owner's project requirements and the important selection of the D&B team.
- The role then becomes similar to the Construction Manager's role in a Construction Manager At Risk delivery method (see Section 2.2.9) with a few differences: since the Owner's control over design is not as tight as in other delivery methods, **the Construction Manager's reviews of the design will need to focus on compliance with the Owner's project requirements and overall cost compliance.**

2.2.3 Main characteristics

The Design-Build system's main characteristics:

a. Combines design and construction under a single contract
b. Traditionally a lump sum contract
c. Generally, two phase procurement
    - Pre-Qualifications
    - Technical/Price evaluation

2.2.4 Applicability

a. Projects that benefit from innovation in design and/or construction
b. Well defined project scope
c. Projects that would benefit from accelerated project delivery
d. Projects having minimal public controversy or third party issues.

2.2.5 Risks

Since the design-build team is working together from the beginning, D&B offers the opportunity to save time and money. However, the advantages of the system are

offset by a significant loss of control and involvement by the Owner and other stakeholders. Accordingly, it is difficult for the Owner to verify that it is receiving the best value for its money without having a great deal of transparency in the D&B team.

The primary attention for an Owner considering D&B is that the Owner should carefully consider the level of involvement it requires for a successful project. First, the Owner needs to recognize the effort and completeness that must be behind its initial scope/preliminary design which forms the basis of its contract with the design-builder. Often, the Owner will require additional Consultants to help it develop the scope or preliminary design, in the role of a traditional design firm.

D&B is best suited to conventional projects for which project requirements can be clearly defined and for which expertise is widely available. For example, a building or a road project might be a project ideally suited for D&B. In a project of this type, the Owner is not assuming undue risk in conceding control over the project, and may benefit from the advantages of D&B.

Another primary consideration of the Owner is proper selection of the D&B team. The Owner should strongly favour D&B teams with a successful track record working together on previous similar projects in the same D&B roles. More so than in any other delivery system, the success of a D&B project may depend on the initial selection process.

Some additional risks:

- Less Owner control over design
- Higher procurement costs for proposers
- Potential to compromise quality
- Considerable time and effort in RFQ[3]/RFP selection process

2.2.6 Advantages

a. D&B can produce a project more quickly than a conventional D-B-B (accelerate delivery by fast-tracking design and construction).
b. There is a single point responsibility for design and construction.
c. Cost efficiencies can be achieved since the Contractor and Design Consultant are working together throughout the entire process.
d. Variation Orders would typically arise primarily only from Owner changes.
e. Potential for innovation and quality enhancement.
f. Reduces error, Variation Orders, and materials overruns.
g. Construction often starts before design completion, so project schedule can be accelerated.
h. Construction cost known and fixed during design, price certainty.
i. Transfer of design and construction risk from Owner to the D&B entity.
j. Emphasis on cost control.

[3] Request for Qualifications

k. Requires less Owner expertise and resources.

2.2.7 Disadvantages

a. Minimal Owner control of both design and construction quality
b. Owner must be highly responsive in its decision making to take full advantage of the speed of D&B.
c. May be problematic when there is a requirement for multiple Agency (many Stakeholders) design approvals.
d. May be inappropriate if the Owner is looking for an unusual or iconic design.
e. Requires a comprehensive and carefully prepared performance specifications.
f. Design changes after construction begins are costly.
g. No party responsible to represent Owner's interests.
h. High bid preparation costs can result to fewer bidders.

2.2.8 Possible Contracting and Procurement methods

2.2.8.1 Contracting method

One common contracting method in the Design & Build delivery method is

a. initially enter into an agreement with the D&B team for
   - a fixed-fee contract for design and pre-construction costs and
   - an agreed General Conditions costs and construction fee given as a percentage of total construction costs.
b. Once the design has progressed to a point where a Guaranteed Maximum Price (GMP)[4] can be established, the contract is converted to a GMP contract, with all fixed costs rolled into the GMP.

Another method used is to enter into a fixed price sum agreement for the entire D&B effort.

2.2.8.2 Procurement - Selection process

On the procurement side, the selection process is typically a two-step process. In a two-step process, step one will involve an Request for Qualifications (RFQ) and teams

[4] guaranteed maximum price (GMP) is a form of agreement with a contractor in which it is agreed that the contract sum will not exceed a specified maximum. Typically, this is a mechanism used on design and build contracts where the contractor has responsibility for completing the client's design and for carrying out the construction works, so they are in a good position to control costs. If the actual cost of the works is higher than the guaranteed maximum price, then the contractor must bear the additional cost. If the cost is lower than the guaranteed maximum price, then the contract should set out whether the savings made go to the client, to the contractor or are shared. This can create a 'pain / gain', or a target cost agreement, where the contractor is incentivised to make savings, but the client has the security of a cost cap.

will only submit their qualifications. The Owner will then establish a short list of teams and an RFP will be issued to these teams, requesting cost information and a technical proposal which defines the project scope along with the firms' innovations, schedule and details that define the quality of the delivered project. The Owner will then make a selection based on a combination of qualifications, approach and pricing[5].

2.2.9 Differences between EPC and Design-Build (D&B) delivery

Engineering, procurement and construction (EPC) contracts is a form of Design - Build (D&B).

EPC (Engineer-Procure-Construct) and Design-Build have both existed as mainstream delivery methods for decades, but what's the difference between the two? They seem to share critical similarities.

In both cases, the owner has a single point of contact on the construction side. In both cases, the contractor is responsible for the design. In both cases, the contractor takes on more risk than a traditional design-bid-build delivery. But several key differences differentiate the two:

a. An EPC project typically results in a turnkey facility. At closeout, the EPC contractor hands over a working facility that's ready to go. A design-build contract closes out similarly to design-bid-build contracts, with the owner and its construction manager or Design Consultant taking an active role in punching out the facility.
b. EPC contractors are often handed little more than performance requirements (output levels, uptime levels, maintenance expense maximums, etc.), whereas most design-build contracts provide at least some design detail in the bridging documents[6].
c. Many contracts transfer far more risk to the contractor in an EPC delivery. Design-build contracts tend to take either a traditional design-bid-build approach to unknowns like hidden site conditions, or to share that risk between the owner and the design-builder. In contrast, it's not uncommon for EPC contracts to shift these risks entirely to the EPC contractor.

Understanding the differences between these two seemingly quite similar design processes is a key step when assessing which delivery system is right for our project.

[5] As with other delivery methods, private Owners may choose to negotiate directly with pre- selected D&B teams at any point in the process above.
[6] "Bridging Document" is a document that aligns and coordinates the requirements and responses of various parties in relation to a specific aspect of a project.

2.3 Construction Management at Risk (CMAR)

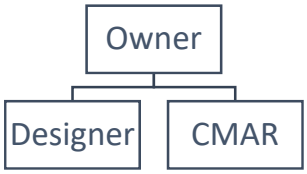


Figure 6: Construction Management at Risk

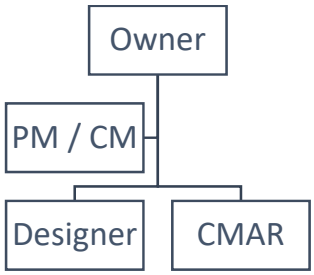


Figure 7: Construction Management at Risk with PM/CM

2.3.1 Description

In this scenario, instead of a traditional general Contractor, the Owner deals with a hybrid construction manager/general Contractor

2.3.1.1 Prior to construction

The "Construction Management at Risk" provides advisory professional management assistance to the Owner prior to construction, offering schedule, budget and constructability advice during the project planning and design phases.

2.3.1.2 During construction

This delivery system is similar in many ways to the Design-Bid-Build system, in that the "Construction Management at Risk" (CMAR) acts as a general Contractor during construction. That is, the "Construction Management at Risk" holds the risk of construction performance and guarantees completion of the project for a negotiated price which is usually established when the design is somewhere between 50% and 90% developed.

2.3.2 Role of the Construction Manager

The role of the Construction Manager in a "Construction Management at Risk" delivery system is sometimes considered redundant. However, there is still a vital role for the Construction Manager to play.

As in other delivery methods, it is important to engage the Construction Manager as early in the project as possible to guide and assist the owner through all phases of project delivery. The Construction Manager will still act as the owner's representative with the rest of the project team, acting as the point of contact for the Design Consultant, "Construction Manager at Risk", and any other specialty consultants engaged in the project by the owner.

The Construction Manager's role in a "Construction Management at Risk" delivery method is similar to the Construction Manager's role in a Design-Bid-Build delivery with one major difference:

the Construction Manager may not be the primary provider of construction expertise and advice to the project team during the pre-construction phases once the "Construction Manager at Risk" firm is engaged by the owner, and as such may not be called upon to perform as many tasks.

An example of this would be that the Construction Manager might not provide estimating or constructability reviews during design phases if the owner relies on the "Construction Manager at Risk" to perform these tasks.

Tasks that will remain with the Construction Manager include verification of schedule, overall project cost tracking, quality control, administration of all contracts, and coordination with all owner stakeholders.

2.3.3 Main characteristics

The "Construction Management at Risk" delivery system's main characteristics:

a. Owner engages a Construction Manager to act as a construction advisor during the pre-construction phase and general Contractor (GC) during construction
b. Selection criteria include qualifications, experience, strategic approach, and cost elements

2.3.4 Applicability

a. Projects where Owner requires control of scope during design
b. Project with multiple phases or contracts
c. Time or funding constraints
d. Complete or obtainable environmental documents and permits

2.3.5 Risks

The primary disadvantages cited in the "Construction Management at Risk" system involve the contractual relationship among Design Consultant, Construction Manager at Risk (CMR) and owner once the price is fixed. The CMR then converts from a professional advisory role of the construction manager to the contractual role of the general contractor. At that time, tensions over construction quality, the completeness of the design, and impacts to schedule and budget can arise.

While the established GMP[7] is supposed to address the remaining unfinished aspects of the design, this can in fact increase disputes over assumptions of what remaining design features could have been anticipated at the time of the negotiated bid.

[7] Guaranteed maximum price (GMP) is a form of agreement with a contractor in which it is agreed that the contract sum will not exceed a specified maximum. Typically, this is a mechanism used on design and build contracts where the contractor has responsibility for completing the client's design and for carrying out the construction works, so they are in a good position to control costs. If the actual cost of the works is higher than the guaranteed maximum price, then the contractor must bear the additional

One mitigating approach to this problem is for the CMR to open its books and share with the owner its subcontractor bids, ensuring transparency in the process. The CMR may further assume risk by taking some responsibility for design errors discovered during construction, if it was involved in the review of the design prior to establishing the GMP. In addition, arrangements can be made regarding risk sharing and profit sharing if there are over-runs or under-runs in the GMP.

2.3.6 Advantages

a. Allows for innovation and constructability during design through collaboration of Construction Manager
b. Reduces error, Variation Orders etc.
c. Identifies and manages risk
d. Owner retains control over design
e. Transfer of responsibility for construction, and some risk, from Owner to Construction Manager
f. Construction cost known and fixed during design
g. Construction Manager has total control of construction and all Sub-Contractors
h. Construction may start before design completion, reducing project time-schedule
i. The owner gains the benefit of having the opportunity to incorporate a contractor's perspective and input to planning and design decisions.

2.3.7 Disadvantages

a. Reduced Owner control of construction
b. Design changes after construction begins are costly
c. Potentially conflicting interests as both Construction Manager and Contractor are same entity
d. While the Construction Manager at Risk provides the owner with professional advisory management assistance during design, this same assistance is not present during the construction phase, as the Construction Manager at Risk is in an "at-risk" position during construction.

2.3.8 Procurement methods

2.3.8.1 Contracting method

A common contracting approach in the "Construction Management at Risk" delivery method is to enter initially into an agreement with the CMR for a fixed-fee contract

cost. If the cost is lower than the guaranteed maximum price, then the contract should set out whether the savings made go to the client, to the contractor or are shared. This can create a 'pain / gain', or a target cost agreement, where the contractor is incentivised to make savings, but the client has the security of a cost cap.

for pre-construction and General Conditions costs, along with an agreed contractor's mark-up fee as a percentage of construction costs.

Once the design has progressed to a point where a GMP can be established, the contract is converted to a GMP contract, with all remaining fixed costs rolled into the GMP.

2.3.8.2 Procurement - Selection process

On the procurement side, the selection process is either a one-step or two-step process. In a one-step process, an RFP is issued and proposals are received that will include qualifications of the team, along with price proposals for the pre-construction costs, General Conditions costs, and construction fee as a percentage. The owner will make their evaluations based on the submitted information.

In a two-step process, step one will involve a Request for Qualifications (RFQ) and firms will only submit their qualifications. The owner will then establish a short list of firms and a Request for Proposals (RFP) will be issued to these firms, requesting the same cost information submitted in the one-step process. The owner will then make a selection based on a combination of qualifications and pricing.

As with Design-Bid-Build, private owners may choose to negotiate directly with pre-selected CMRs.

2.4 Construction Manager as Adviser

The Construction Manager as Adviser (CMa) project delivery format arose in the public sector as a response to the deficiencies in the multiple prime model (see Section 2.1.1) caused by lack of effective management, and in the private sector where owners sought the services of a cost, constructability and scheduling consultant on a "fee for services" basis.

In a typical setting, the CMa is engaged early in the preconstruction phase and works in tandem with the owner and the Design Consultant, providing cost, constructability and scope review, bid packaging, and similar services.

The CMa facilitates the contractor bidding and selection process, and provides a broad range of construction phase services, including scheduling, site observation, payment application processing and closeout administration. In certain situations, the Construction Manager, is authorized to act on behalf of the owner and enter into contracts on the owner's behalf, but without taking financial risk with respect to those contracts.

The perceived advantages of the CMa approach derive from the management expertise supplied by an independent and neutral construction professional early in the project. While CMa provides for enhanced management, the principal disadvantage is that the owner continues to hold the individual construction

contracts, and the CM typically takes no financial risk for non-performance of those contractors. Accordingly, the owner obtains no cost or schedule guarantee from a single party and is exposed to direct claims from multiple contractors.

2.5 Public Private Partnership (PPP)

2.5.1 Description

Public Private Partnership is a delivery method whereby a public entity partners with a private entity for the purpose of delivering public infrastructure. In the most typical of these variations, the private entity will be comprised of

- a design-build team,
- a maintenance firm, and
- a lending firm.

This entity will design, build, finance, maintain and/or operate the facility for a set number of years, agreeing to meet specified performance criteria in exchange for lease payments or some other compensation. At the end of the specified period, the facility is returned to the public entity.

Various forms of PPP compensation include a fee contract, in which the PPP firm receives its compensation through a fee charged to the Owner, and a concession contract, in which the PPP firm receives its compensation directly from the consumers rather than the Owner.

2.5.2 Possible schemes of PPP

Build-Finance	In build-finance projects, the private sector assumes responsibility both for financing and building the project.
Design-Build-Maintain (DBM)	In this scenario the private sector assumes responsibility for the design and construction of the project. After construction is complete, the public sector takes ownership, but the private sector entity continues to maintain the constructed facility under an ongoing maintenance agreement.
Design-Build-Finance-Maintain (DBFM)	In a Design-Build-Finance-Maintain project, in addition to design and construction of the facility, the private sector is responsible for the financing the project. As in the designbuild-maintain model, once construction is complete, ownership of the facility goes to the public sector but the facility is maintained privately under an ongoing maintenance agreement.
Design-Build-Finance-Operate (DBFO)	In another variation, the Design-Build-Finance-Operate model sees the private sector, after having designed and built the facility with private financing, continue to operate and maintain it for the duration of the concession period, which may be 30 years or more. Only after the agreement has expired ownership of the facility returns to the public sector.

2.5.3 Role of the Construction Manager

The role of the Construction Manager in a PPP delivery system will be very similar to the Construction Manager's role in any other Design & Build delivery system, although often there is much more of a program management focus. It would be important for the Construction Manager to have experience specific to PPP projects since there are many unique characteristics related to this process.

As always, this role can be filled with qualified personnel either through Owner's staffing or through a third-party firm. The Construction Manager tasks will include verification of schedule, overall project cost tracking, quality assurance, administration of all contracts, and coordination with all Owner stakeholders.

2.5.4 Risk Analysis

PPP has gained much attention due to its ability to **provide a funding option for public entities** that may be struggling to identify adequate sources of capital. While this approach is a good option as a means of bringing a project to reality, it is also a very complicated process that needs to be carefully considered.

2.5.5 Advantages

PPP can benefit public projects in the following ways:

a. Targets alternative revenue and funding sources to close a funding gap
b. Allows use of low cost tax-exempt or taxable financing
c. Transfers risk to the private sector
d. Takes advantage of private-sector efficiencies and innovations in construction, scheduling, and financing
e. Provides efficiencies in long-term operations and maintenance
f. Presents an opportunity to combine public and private uses in mixed-use developments to leverage economic development

2.5.6 Disadvantages

Disadvantages of PPP include:

a. The Owner may experience higher total life cycle costs.
b. The proposal process can be very expensive for all involved.
c. A high level of expertise is required to execute a PPP project.

3 The selection of the proper delivery method

3.1 Project Delivery Selection Matrix

The descriptions of the project performance criteria are an expression of the level that can be achieved, noting that for each individual project the actual results may vary. The various criteria are interdependent, for example a highly-qualified Owner's team will usually produce clear, accurate and thorough user requirements, which in turn will result in higher quality contract documents.

Higher quality contract documents will generally result in better quality design, which in turn will likely produce better quality construction.

The appropriate budget and time must be allocated to achieve a high quality project. When an Owner places restrictions on one of the criteria it will likely cause negative impact on other criteria. When selecting the most suitable delivery method the Owner should consider the sum of the criteria as well as the individual criteria.

The Canadian Design Build Institute has prepared an assessment matrix to help assist in evaluating a specific project against the various project delivery methods[8]. A copy of the matrix is presented next. As noted at the beginning, an Owner should consider not only the individual criteria, but the sum of the same. This list is not meant to be exhaustive, but it definitely covers the significant areas to con- sider and provides a useful tool.

Stage	Project Performance Criteria	Design-Bid- Build	Design-Build	Construction Management
Design	For what project complexity is the delivery method best suited?	low to high	low to moderate	low to moderate
	To what extent must user requirements be defined prior to tender?	well defined	well defined	not fully defined
	What level of design quality is characteristically achieved with the delivery method?	high	high	high

[8] Canadian Design & Build Institute Practice Manual, Document 205 'Methodology Assessment Matrix'—Revised 2007

Stage	Project Performance Criteria	Design-Bid- Build	Design-Build	Construction Management
	Which delivery method provides multiple design proposals for Owner consideration?	no	yes	possibly
	How complex is the design review process for the Owner?	moderate	simplified	more complex
	To what extent can the delivery method accommodate scope/design changes during construction phases?	low	low	high
	To what extent does the delivery method inherently minimize changes?	moderate	high	moderate
	To what degree do the Owner and user have direct contact with the Design Consultant and are they able to directly Influence the design?	high	low	high
Schedule	To what extent can the delivery method achieve accelerated delivery, or ensure delivery to specific schedule?	low	moderate to high	moderate to high
	Ability to accommodate early construction start?	low	low to moderate	high
Cost	Potential to obtain an early cost commitment?	low	high	moderate
	To what extent does the method accommodate adjustments to scope during construction to achieve final costs within budget?	low	moderate	high
	To what ability can the delivery method reduce claims/cost for changes and delays?	low	high	moderate

Stage	Project Performance Criteria	Design-Bid- Build	Design-Build	Construction Management
	Ability to manage cash flow?	low	low	high
	To what extent does the method permit the Owner to influence systems, materials and construction methods to minimize life cycle costs?	high	moderate	high
Contracting	To what extent is the required design and construction experience and knowledge available for the method?	high	low	moderate
	Ability to prequalify the prime Contractor on publicly funded projects?	low	high	moderate
	To what extent does the method employ a simple bid evaluation and selection system?	high	low	moderate
	What level of construction quality can be achieved with the applicable delivery method?	higher	higher	higher
Risk	To what extent does the method permit the Owner to transfer the liability for design errors and omissions, delays, construction errors and omissions and non-conformances to contract documents?	low	high	low
General	To what extent do Owners have the experience and knowledge required to employ the method?	high	low	low

3.2 Proposal for delivery methods for road projects

Next some categories of projects for the road infrastructure are mentioned.

(A) Road infrastructure (incl. paved / unpaved roads, bridges, tunnels, culverts, retaining walls, signage etc.)
(B) Road infrastructure with toll stations
(C) Traffic lights
(D) Rest Areas
(E) Weigh stations
(F) Public Toilets on the roads
(G) Petrol Stations

Next table presents for discussion some most suitable project delivery methods per project category[9]:

	D-B-B	D&B	CMAR	CMA	PPP		
					DBM	DBFM	DBFO
Section	2.1	2.2	2.3	2.4	2.5.2		
(A) Road infrastructure	**X**	**X**	**X**	**X**			
(B) Road infrastructure with toll stations	**X**	**X**	**X**	**X**		**X**	**X**
(C) Traffic lights (Installation, Maintenance)					**X**		
(D) Rest Areas						**X**	**X**
(E) Weigh stations						**X**	**X**
(F) Public Toilets on the roads						**X**	**X**

Choosing a project delivery method several factors in making the decision, should be also considered (Section 1), including:

(1) Project size
(2) Type of project
(3) Legislative and regulatory requirements
(4) Tolerance for risk
(5) Time-Schedule
(6) Local market conditions
(7) Desired level of involvement

[9] Please note that table presents some possibly most suitable project delivery methods. This table to be a guide, all delivery methods to be considered and best method to be selected case by case.

(8) Owner's resources and capabilities

4 References

[1] The Construction Management Association of America, AN OWNER'S GUIDE TO PROJECT DELIVERY METHODS, 2012

[2] IDAHO, Transportation Department, PROJECT DELIVERY METHODS

[3] Jody Becker and Tim Murphy, ALTERNATIVE CONSTRUCTION DELIVERY METHODS

ANNEX A: An Overview of Project Delivery Methods

	Design-bid-build (D-B-B)	Design & build (D&B)	Construction manager at risk (CMAR)	Public private partnership (PPP)

Main characteristics	• Traditional delivery system
	• Owner contracts separately for design and construction services
	• Bid based on complete (100%) plans and specifications
	• Owner retains high level of control and risk
	• Traditionally a unit priced contract
		• Combines design and construction under a single contract
		• Traditionally a lump sum contract
		• Generally, two phase procurement
		  ○ Pre-qualifications
		  ○ Technical/price evaluation
			• Owner engages a construction manager to act as a construction advisor during the pre-construction phase and general contractor (GC) during construction
			• Selection criteria include qualifications, experience, strategic approach, and cost elements
				• PPP is a delivery method whereby a public entity partners with a private entity for delivering public infrastructure.
				• In the most typical of these variations, the private entity will be comprised of
				  ○ A design-build team,
				  ○ A maintenance firm, and
				  ○ A lending firm.

Applicability	• Projects where the owner needs to completely define the scope • Significant risks or third-party issues (utilities, environmental) that can be best resolved or managed by the owner.	• Projects that benefit from innovation in design and/or construction • Well defined project scope • Projects that would benefit from accelerated project delivery • Projects having minimal public controversy or third party issues	• Projects where owner requires control of scope during design • Project with multiple phases or contracts • Time or funding constraints • Complete or obtainable environmental documents and permits	

	Design-bid-build (D-B-B)	Design & build (D&B)	Construction manager at risk (CMAR)	Public private partnership (PPP)
Risks	• Initial low bid might not result in ultimate lowest cost or final best value • Higher level of inspection/testing by the owner • Owner bears risk of design adequacy • Potential antagonistic relationship among the contracting parties • Limited opportunity to incentivize contractors to provide enhanced performance (cost, time, quality)	• Less owner control over design • Higher procurement costs for proposers • Potential to compromise quality • Considerable time and effort in RFQ[10]/RFP selection process	• Tensions over construction quality, the completeness of the design, and impacts to schedule and budget can arise	• While this approach is a good option as a means of bringing a project to reality, it is also a very complicated process that needs to be carefully considered.
Advantages	• Applicable to a wide range of projects • This method is widely applicable, well understood, and has well-established and clearly defined roles for the parties involved. • This method is the most common approach for public owners having to	• D&B can produce a project more quickly than a conventional D-B-B (accelerate delivery by fast-tracking design and construction). • There is a single point responsibility for design and construction. • Cost efficiencies can be achieved since the	• Allows for innovation and constructability during design through collaboration of construction manager • Reduces error, variation orders, and materials overruns • Identifies and manages risk	• Targets alternative revenue and funding sources to close a funding gap • Allows use of low cost tax-exempt or taxable financing • Transfers risk to the private sector • Not subject to capital budget allocations

[10] Request for Qualifications

	Design-bid-build (D-B-B)	Design & build (D&B)	Construction manager at risk (CMAR)	Public private partnership (PPP)
	comply with local or state procurement statutes. • Owner controls design and construction. The owner has a significant amount of control over the end product, particularly since the project's features are fully determined and specified prior to selection of the contractor. • Design changes easily accommodated prior to start of construction • Design is complete prior to construction award • Construction cost is fixed at contract award • Relative ease of implementation	contractor and Design Consultant are working together throughout the entire process. • Variation orders would typically arise primarily from owner changes. • Potential for innovation and quality enhancement • Reduces error, variation orders, and materials overruns • Construction often starts before design completion accelerating project schedule • Construction cost known and fixed during design, price certainty • Transfer of design and construction risk from owner to the D&B entity • Emphasis on cost control • Requires less owner expertise and resources	• Owner retains control over design • Transfer of responsibility for construction, and some risk, from owner to construction manager • Construction cost known and fixed during design • Construction manager has total control of construction and all sub-contractors • Construction may start before design completion, reducing project schedule • The owner gains the benefit of having the opportunity to incorporate a contractor's perspective and input to planning and design decisions.	○ Accelerates construction starts ○ Reduces construction cost and interest rate risks • Takes advantage of private-sector efficiencies and innovations in construction, scheduling, and financing • Provides efficiencies in long-term operations and maintenance • Presents an opportunity to combine public and private uses in mixed-use developments to leverage economic development
Disadvantages	• Design and construction are sequential, typically resulting in longer schedules	• Minimal owner control of both design and construction quality • Owner must be highly responsive in its decision	• Reduced owner control of construction • Design changes after construction begins are costly	• The owner may experience higher total life cycle costs. • The proposal process can be very expensive for all involved.

	Design-bid-build (D-B-B)	Design & build (D&B)	Construction manager at risk (CMAR)	Public private partnership (PPP)
	• Can lead to a more costly final product. • Exposure to contractor variation orders and claims over design and constructability issues. • May promote more adversarial relationships rather than cooperation or coordination among the contractor, the Design Consultant and the owner. • If fixed price bidding and compensation method: the contractor may pursue a least-cost approach to completing the project and the owner may receive less scope or lesser quality than expected. • If unit price bidding and compensation method: the contractor may pursue an increased-scope approach to maximize revenue from the contract, while providing the owner more scope than expected.	making to take full advantage of the speed of D&B. • May be problematic when there is a requirement for multiple agency (many stakeholders) design approvals. • May be inappropriate if the owner is looking for an unusual or iconic design. • Requires a comprehensive and carefully prepared performance specification • Design changes after construction begins are costly • No party responsible to represent owner's interests • High bid preparation costs/fewer bidders	• Potentially conflicting interests as both construction manager and contractor • While the construction manager at risk provides the owner with professional advisory management assistance during design, this same assistance is not present during the construction phase, as the construction manager at risk is in an "at-risk" position during construction.	• A high level of expertise is required to execute a PPP project.

	Design-bid-build (D-B-B)	Design & build (D&B)	Construction manager at risk (CMAR)	Public private partnership (PPP)
	• May limit the effectiveness and constructability of the design. • Requires significant owner expertise and resources • Owner at risk to contractor for design errors • Construction cost unknown until contract award • No contractor input in design, planning or value engineering (VE).			
Possible Contracting and procurement methods	• In case of vertical construction (a building or treatment facility): sealed lump-sum or fixed price bid. • In case of horizontal projects (as transportation): bidding is unit price.	• Agreement with the D&B team for ○ A fixed-fee contract for design and pre-construction costs and ○ An agreed general conditions costs and construction fee given as a percentage of total construction costs. • Once the design has progressed to a point where a guaranteed	• Fixed-fee contract for pre-construction and general conditions costs, along with an agreed contractor's mark-up fee as a percentage of construction costs. • Once the design has progressed to a point where a GMP can be established, the contract is converted to a GMP contract, with all remaining fixed costs rolled into the GMP.	

	Design-bid-build (D-B-B)	Design & build (D&B)	Construction manager at risk (CMAR)	Public private partnership (PPP)
		maximum price (GMP)[11] can be established, the contract is converted to a GMP contract, with all fixed costs rolled into the GMP.		

[11] guaranteed maximum price (GMP) is a form of agreement with a contractor in which it is agreed that the contract sum will not exceed a specified maximum. Typically, this is a mechanism used on design and build contracts where the contractor has responsibility for completing the client's design and for carrying out the construction works, so they are in a good position to control costs. If the actual cost of the works is higher than the guaranteed maximum price, then the contractor must bear the additional cost. If the cost is lower than the guaranteed maximum price, then the contract should set out whether the savings made go to the client, to the contractor or are shared. This can create a 'pain / gain', or a target cost agreement, where the contractor is incentivised to make savings, but the client has the security of a cost cap.