CSCE Annual Conference

Growing with youth – Croître avec les jeunes

Laval (Greater Montreal)

June 12 - 15, 2019

EFFECTIVE TOOLS FOR PROJECTS DELIVERED BY PROGRESSIVE DESIGN-BUILD METHOD

Simon A. Adamtey[1] and Lameck M. Onsarigo[2]

[1]Construction Management Department, Kent State University, Kent OH; Email: sadamtey@kent.edu

[2]Construction Management Department, Kent State University, Kent OH; Email: lonsarig@kent.edu

Abstract: Progressive design-build (PDB) is a new and distinctive method where an owner procures the services of a design-builder based primarily on qualifications or best value without final price and schedule commitment as part of the process. PDB leverages the benefits of design-build (DB) where one contractor is selected for both design and construction, and the benefits of construction manager-at-risk (CMAR) where the owner has input and control over the preconstruction phase. The collaboration between the owner and the DB team encourages innovation and provides performance guarantees. Being a new method coupled with a lack of long-term experience necessitates continued investigation of the effective tools and success factors for improved implementation. To this end, this research study was conducted to further facilitate research and applications of PDB. This paper discusses the results of a comprehensive literature review and analysis of current applications. Publications including journal articles, conference proceedings, case studies and reports were reviewed. The analysis revealed that some of the effective tools include owner education, risk assessment criteria, project selection criteria, proposal evaluation criteria, balanced collaborative contract, project packaging, open book pricing and continuous evaluation. Additionally, the paper addresses the differences between PDB and DB, the benefits of PDB, and the challenges and potential obstacles to a successful PDB delivery. This paper contributes to the existing PDB knowledge facilitating further research and applications by both academic and industry stakeholders.

1 BACKGROUND

In the United States, the traditional Design-Bid-Build (DBB) contracting for many years has been the form of project delivery required by law for the owners of most public-works projects (ASCE 2012). Owners of many private projects also frequently choose DBB contracting. Although DBB has proven effective overall, weaknesses such as lack of contractor input, which limits constructability, and the longer overall project durations have led to consideration and use of alternative delivery methods (ADM) such as design-build (DB) and construction manager-at-risk (CMR) (Smith, Currie & Hancock 2015). In addition, variable outcomes, increased project size and complexity, time pressures, changes in technology and continuous need for improvement have fostered a competitive landscape where new methods of procurement are continuously being sought to improve project performance (Raisbeck, Millie and Maher 2010).

The ADMs primarily changed the contracting structure of DBB by promoting the integration and collaboration between the owner, the engineer/designer, and the contractor. The early contractor involvement in the design phase has widely been recognized to result in significant benefits for the project owner by producing a more constructable project, which often translates into earlier cost and schedule certainty (Lopez del Puerto, Craigie and Gransberg 2016). According to the Design-Build Institute of America (DBIA), the fastest growing and most popular alternative contracting method used to deliver construction projects in America is design-build (DBIA 2018, FMI 2018). While studies have shown that projects delivered through DB perform better in terms of cost, quality and schedule than those using DBB and CMR (Molenaar and Franz 2018), it is recognized that the quality of the projects is constrained by the fixed cost used in selecting the design-builder (Gransberg and Molenaar 2004). Consequently, this can

inhibit creativity and innovation during the design stage. This is because when cost is part of the selection criteria for the design-builder, the design-builder is put in a position to only design to meet the cost ceiling, (lump sum or guaranteed maximum price), which may not produce the highest quality of project. Additionally, owner's ability to be actively involved in the design is acutely limited. The ability of an owner to collaborate with the design-builder on the design to explore alternatives without the initial cost constraint is a potential benefit that has not been widely recognized and studied.

To explore this benefit and promote innovation during the design phase, there is an emerging variation of the DB method known as progressive design-build (PDB) that eliminates cost in the design-builder selection and allows an owner's input in the design. PDB allows an owner to procure the services of a design-builder based primarily on qualifications or best value without final price and schedule commitment as part of the process (DBIA 2017). PDB leverages the benefits of DB where one contractor is selected for both design and construction, and the benefits of CMAR where the owner has input and control over the preconstruction phase. Being a new method coupled with a lack of long-term experience necessitates continued investigation of the effective tools for improved implementation. To this end, the goal of this research study was to further facilitate research and applications of PDB through a comprehensive literature review and case studies.

2 PROGRESSIVE DESIGN-BUILD CHARACTERISTICS

The fundamental characteristic of the PDB method is the selection of the design-builder primarily based on qualifications before the design phase allowing the owner and the design-builder to work together to advance the design. The term "progressive" specifically refers to the iterative approach to concurrently progress the design detail and the construction cost estimate of a project (Clark 2016). According to DBIA (2017), PDB core features include the following:

- The owner retains the design-builder early in the life of the project and in some cases before the design is developed at all.
- The design-builder is generally selected primarily, if not exclusively, on qualifications and the design-builder's final project cost/price and schedule commitment is not established as part of the selection process.
- The design-builder delivers the project in two distinct phases: Phase 1 includes budget-level design development, preconstruction services and the negotiation of a firm contract price (either lump sum or guaranteed maximum price) for Phase 2; and Phase 2 includes final design, construction and commissioning.

The procurement of the design-builder can either be a one or two-step process (Gates, et al. 2017). The one-step process involves procuring the design-builder solely on qualifications. The process begins by the owner sending out Request for Qualifications (RFQ) and allowing qualified design-builders to submit their Statement of Qualifications (SOQ). The owner reviews the SOQs, conducts interviews and one design-builder is selected. The one-step process is best suited for projects where the schedule is a critical driver. The two-step process involves both RFQ and Request for Proposals (RFP) in selecting the design-builder. The owner first uses the RFQ to shortlist up to three qualified design-builders (Parkinson and Neumayr 2018). The short-listed firms are then allowed to respond to the RFP and one is selected. In this case, the focus of the proposal evaluations is more on the project approach than the fee.

Figure 1 provides a flow chart of the PDB process. The programming services phase is where the owner and the design-builder begin to collaborate on the design. The program of the design-builder in the RFP is verified, the scope of work including the preliminary schedule established and the key trades are identified (Parkinson and Neumayr 2018). The design may be broken into different packages and target estimates or budgets established for each package. As the design progresses, progressive estimates are prepared for the packages through price negotiations of competitive bids from key trades and material and equipment vendors. Sudsequently, the design-builder prepares and provides preliminary GMP at the design completion of each package. By packaging the work, construction can begin early for completed packages, thus allowing the project to be completed as early as possible. Since price negotioations are tied to the

value of a particular design package and the quantities of work contained in it (Alleman, et al. 2017), it simplifies the preparation of the progressive estimates by reducing the scale of each negotiation (Gransberg and Molenaar 2019). At each stage of the progressive estimates, the owner is alerted to estimates exceeding target budgets affording the owner and the design-builer enough time to react and recover the budget through value engineering. It is also feasible to ascertain with more certainty the risk involved for each package.

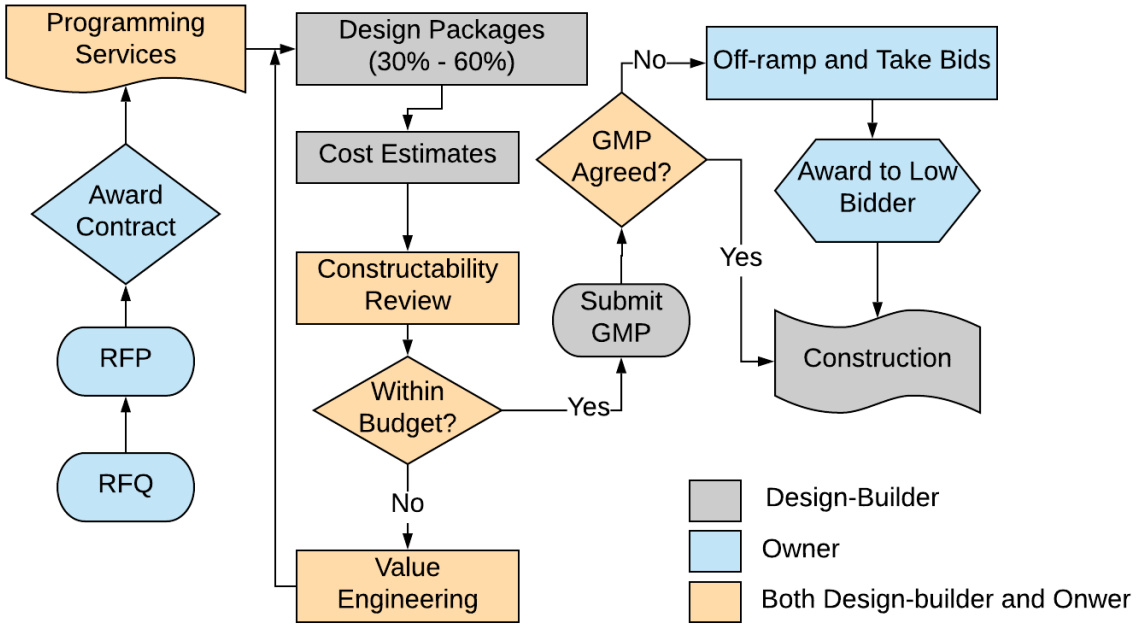

Figure 1: Progressive Design-Build flow chart

At some point, the design-builder is required to provide a GMP for the entire project. Athough the GMP can be potentially established at the end of the design award, there is a huge risk of schedule and design uncertainty which may lead to an inflated GMP. With a lot of uncertainties, there is the potential of a longer price negotiation which may delay the schedule of the project. However, as the design and buyout progresses, the GMP can be negotiated when everyone is comfortable and most risks concerning design and schedule uncertainty are resolved. This is typically within 60% and 90% of design completion (Kora, et al. 2017).

The nature of the progressive estimates and GMP ensures open book pricing. This means that all cost estimates are developed in a completely transparent manner. The open-book approach provides the owner transparent access to project costs and the ability to factor quality considerations into the selection of subcontractors and vendors (Brown and Caldwell 2017). For example, the owner could require that there is no self-perform work, thus maximizing the work that is competitively procured. Contingencies are also visible throughout the process, providing an opportunity for retiring unrealized specific risk-related contingencies as the work progresses beyond a point where the project is no longer exposed to that risk (Gransberg and Molenaar 2019).

Although the progressive GMP reduces the potential of not reaching an agreemant, there is the possibility that the design-builder and the owner may not mutually agree on the GMP. In the event the owner finds the design-builder's GMP unacceptable, the owner can take the "off ramp" path by competitively bidding the project in a manner similar to a design-bid-build and award the construction phase to a new contractor. The design-builder may be retained to provide the owner traditional construction management services (Brown and Caldwell 2017).

2.1 Advantages, Disadvantages and Challenges of Progressive Design-Build

As an alternative delivery method, PDB enjoys all the benefits of early contractor involvement in the design phase for constructability review, which often leads to early cost and schedule certainty (Lopez del Puerto, Craigie, and Gransberg 2016, Shrestha and Fernane 2016). The two features of the PDB method, owner's involvement in the design phase and the selection of the design-builder based on qualifications, provide several advantages for the owner. The owner is afforded the opportunity to collaborate on the design, which allows for enhanced owner control of the scope, quality, price and schedule decisions (Brown and Caldwell 2017). The qualification-based selection in addition to the required collaboration between the design-builder and owner allow the highest level of input and promote the best possible environment to foster innovation during the design phase. The more cited advantage is the ability to negotiate the risk profile as the design progresses (Loulakis 2019, Clark 2017). Since the design-build team is working collaboratively with the owner, risks can be identified and mitigated earlier in the design phase resulting in a GMP that reflects the actual cost to construct the project. Progressive estimates and schedules are also easier to manage and ascertain with more certainty because the scope can be adjusted to fit budget and schedule changes imposed by new information (Gransberg and Molenaar 2019).

The extensive involvement of the owner and the nature of progressive design and estimates can practically eliminate change orders during the construction phase (Brown and Caldwell 2017). One of the key features of PDB is the absolute transparency of the open-book process. Through this process, the owner can have the absolute assurance that they have received the best market-driven pricing. PDB also affords the owner the opportunity to take the "off-ramp" path in the event there is no agreement on the GMP.

While PDB can be very advantageous to the owner and the project performance, it is important to note that PDB is only a good option when an owner is interested and can be intensively involved in the design decisions. The most cited disadvantage or concern of PDB is the perceived lack of competitive selection because of the elimination of price in the design-builder selection (Kora et al. 2017, Culp 2017). Unlike the traditional design-build, the construction cost is not known at the time of initial contract award. According to Corey (2016), while it is true that the fixed price for the entire project is not a factor for selection in a PDB project, other pricing factors such as design fees, the design-builder fee, general conditions for the project or other pricing elements can be used as evaluation tools if desired by the owner (Corey 2016). In the event of an off-ramp decision, the owner would have to bid the project and select a new contractor. This can potentially impact the project schedule and quality.

The most significant challenge for public owners is the state and local procurement laws that may prevent award of contract without price evaluation. For example, the state of Virginia does not expressly permit PDB because it requires price consideration in the RFP (Awezec, Doller and Hughes 2013). Although price is not the sole determining factor, by requiring price as a factor in the selection process eliminates PDB as an option for public owners. A potential challenge for owners is the desire to change existing evaluation methods in RFPs to craft an objective evaluation criterion and scoring methodology without price.

Being a new process, PDB requires a change in mindset and approach, and an understanding of the procurement process and responsibilities involved. The challenge here is the ability of the owner to fully participate in scope advancement, buyout negotiations and GMP negotiations (Alpert and Tunnicliffe 2011). According to Kora et al. (2017), an owner can elect to hire an engineer or a representative to assist in overseeing the work by the design-builder and provide a third-party opinion of the buyout negotiations and the GMP.

3 PROGRESSIVE DESIGN-BUILD COMPARED WITH DESIGN-BUILD

In both PDB and traditional DB, the owner contracts with a single design-builder for both design and construction services providing the owner with a single point of responsibility. However, there are major procurement and structural differences. The key differences between PDB and DB are summarized below.

- **Procurement:** In PDB, the design-builder is selected exclusively on qualifications with little or no design information provided. The total estimate of the project is not evaluated in awarding the

contract. While in DB, the design-builder is selected based on technical and price proposals with the total estimate being a major factor in awarding the contract (Loulakis and Kinsley 2017). DB proposals also include about 30-60% design development.

- **Contract:** The main contracting approach used in PDB is GMP resulting from the progressive GMP while in DB, owners use a lump sum approach, with no visibility into design-builder's actual incurred costs (Loulakis and Kinsley 2017).
- **Collaboration:** In PDB, the owner and the design-builder collaborate on the programming services, which include scope, preliminary schedules, target budgets, and key trades selections. This affords the owner some control over the design, schedule and cost estimates. In DB, the design-builder is introduced to the project after the owner has developed basis of design. There is limited collaboration between design-builder and the owner on the design matters and most design decisions are often made in isolation (DBIA, 2017, Loulakis and Kinsley, 2017).
- **Open Book Pricing:** In PDB, the owner can make informed and real-time decisions during the progressive designs because the owner has access to the design-builder's estimating and cost information. With open-book pricing, there is an assurance that the owner is getting the best price at market conditions. There is no open-book pricing in DB. The owner has no access to any meaningful cost data from the design-builder until after contract award (DBIA 2017). There is also no guarantee that the owner is getting the best market price.
- **Design Risks:** The *Spearin Doctrine* requires that an owner furnishes the contractor an implied warranty on the quality and completeness of the design, making it liable for any errors and/or omissions present in the construction documents at the time the contract is awarded (Gransberg and Molenaar 2019). The collaborative nature of PDB, the design-builder's confirmation of design completion, and the commitment to price after design has been developed allow the owner to avoid *Spearin* risk. However, in DB, the owner often retains *Spearin* risk for errors in bridging documents that could not have reasonably been discovered by design-builder during procurement (Loulakis and Kinsley 2017).
- **Off-ramp:** If the owner and the design-builder do not agree on the GMP, the owner has the option of employing the services of another contractor to construct the project. This could be disadvantageous to the owner because of the potential of delaying the project. In DB, the owner does not have the option of "off-ramp". However, the owner still has the right to terminate the contract for reasons applicable under the contract.

4 METHODOLOGY

The aim of this paper is to facilitate further research and applications of PDB by investigating the effective tools and success factors. To achieve this objective, the researchers utilized a qualitative research approach by first conducting a comprehensive literature review followed by review of published case studies. The first step in the review was to identify journals, conferences, databases and websites that may contain relevant material for this review. The search was conducted broadly on databases such as ScienceOpen, SCOPUS, Google Scholar, and EBSCO. Most of the publications are in the airport, transit, and water/wastewater sector. This was expected because PDB has been used at least for two decades in this sector. It is important to state that PDB is yet to be fully adopted by the highway construction sector (Gransberg and Molenaar 2019). A review of three published case studies was conducted to identify, in addition to the literature review, the effective tools emanating from the lessons learned and success stories.

The first PDB case study was the modifications of the Detroit's Water Resource Recovery Facility (WRRF) to achieve disinfection under all flow conditions. This is the largest single site wastewater treatment plant in North America that serves a combined sewer system with a wet weather capacity of 1,700 MGD and secondary treatment capacity of 930 MGD. Great Lakes Water Authority elected PDB to streamline the procurement process and allow for innovation to meet compressed delivery timeframe. Commencement of construction begun by April 1, 2017 with a projected substantial completion deadline of April 1, 2019. The second PDB case study reviewed was the new headquarters of DC Water completed in 2016. DC Water

used PDB to select Skanska USA Building with SmithGroup as the lead architect. The project is an office building of 150,000 square feet (Architect 2016). The third PDB case study reviewed was the upgrade and expansion of the pollution control plant in the city of Warner Robins. The city utilized the PDB method to deliver the facility solutions that met permitting requirements. Haskell was selected as the design-builder and through collaboration with the city, it was able to deliver the project and saved the city over 21 million dollars for the 12 MGD capacity plant (Haskell 2014).

5 FINDINGS AND DISCUSSIONS

The literature review results were compared with the case studies to validate the results and ensure completeness of the effective tools identified. Each identified tool is discussed below.

5.1 Effective Progressive Design-Build Tools

The effective techniques employed in PDB with the number of observations in the literature review and the project phase each tool relates is presented in Table 1. The frequency of these tools in the literature underscores their importance to the successful performance of PDB.

Table 1: Effective Progressive Design-Build tools

Tool	No.	Project Phase	Responsibility
Owner education	12	Pre-procurement	Owner
Risk assessment	9	Procurement	Owner and DB team
Project selection criteria	7	Procurement	Owner
Proposal evaluation criteria	8	Procurement	Owner
Balanced collaborative contract	8	Procurement and construction	Owner and DB team
Project packaging	9	Design development	Owner and DB team
Open book pricing	10	Entire project	Owner and DB team
Continuous evaluation	6	Entire project	Owner and DB team

5.1.1 Owner education

Owner education is the first tool that must be implemented in the pre-procurement phase. A well-structured formal education should provide a thorough understanding of PDB and help prepare the owner for the process. Owners should understand the potential benefits, limitations, and attributes of PDB so that they can make informed decisions as to whether the use of PDB will benefit their project (DBIA 2015). Specialized training in PDB for all stakeholders is essential to maximizing the utility of integrated PDB. Both evaluators and stakeholders should be educated to manage their expectations about what is going to happen during the process. Additionally, it is important to understand why PDB is significantly different than the traditional DB method and other methods so that the owner can clearly define the different roles and responsibilities of the parties for an integrated PDB contract

Key hurdles that must be overcome are owner's mindset and organizational culture. Owners who have experience with DB may approach PDB with a DB mindset and this may hinder the realization of the full benefits of PDB. Unlike DB, in PDB the organization endures short-term uncertainty over pricing to realize longer-term savings in schedule and change order costs (Kora, et al. 2017).

Public owners should understand all procurement constraints imposed or flexibilities afforded by their legislative, regulatory, or internal requirements**.** Regulatory and procurement laws may not allow for qualification-based procurement without price evaluation and this may make PDB unauthorized.

5.1.2 Risk assessment criteria

The owner, before procurement, should perform initial risk assessment. Owners should use a rigorous and equitably-balanced project risk assessment process early in the procurement process and update or refine the risk assessment as the project proceeds from procurement through project execution (Kora, et al. 2017). Owners should carefully research and assess current market conditions as they plan their PDB programs because it will help identify potential risks and opportunities. Among the issues to be researched and assessed include: (a) procurement actions that could limit or expand competition; (b) projected labor, material and equipment availability; (c) lessons learned from similar projects; and (d) realism of budget and schedule estimates (DBIA 2013). The initial risk assessment should also form the basis for the project goals. It is recommended that these project goals should be aspirational. For example, instead of saying on-time completion, say minimize schedule, and instead of saying on budget, say below budget (Parkinson and Neumayr 2018).

Risks assessment should be iterative and should be performed for each package of work with the design-builder. Major risks to consider for the owner include lack of defined scope for the project, lack of upper price for the project, and painful “off ramp” decision. For the design-builder, some major risks to consider include unreasonable expectations from owner, conflicting stakeholder input, compliance with project parameters and reduced ability to claim for changes.

5.1.3 Project selection criteria

The choice of project delivery method greatly influences the project outcome and its one of the most important factors that determines a project’s success (Al Khalil 2002). Knowing that PDB may not be suitable for all projects, owners should have a well-structured criterion to identify and select the appropriate projects for PDB. The project selection criteria is an effective tool to establish a decision-making process for the project and allow the owner to evaluate the suitability of other available delivery methods. For example, PDB may be suitable if schedule is a critical driver, maximum owner/design-builder collaboration is a priority and if the owner wants to have control over the procurement and design process.

5.1.4 Proposal evaluation and team selection criteria

Proposal evaluation is an objective tool that is used to assess strengths and weaknesses of proposals. The evaluation should enable identification of strengths that are more likely to exceed project goals and achieve design excellence, and weaknesses that are less likely to achieve project goals and achieve design excellence (Parkinson and Neumayr 2018). A typical method to determine design excellence is the evaluation of past performance on similar projects. This underscores the notion that a good measure of how people are going to perform in the future is often times informed by what they have done in the past. The criteria should allow shortlisted SOQs to present how they have achieved design excellence in the past and how they plan to do same on the current project.

The criteria should also allow for consensus scoring for the evaluating team. An example of scoring methodology is shown in Table 2 adopted from Awezec, Doller, & Hughes (2013). Fee and rate proposals are not evaluated or not a significant portion of the evaluation criteria for both the single-step and two-step procurement approach.

When an owner decides to use PDB, it should have a single fundamental procurement objective of selecting the right team using a streamlined process. A team that is willing to collaborate and the owner believes is trustworthy, fair and transparent is paramount to the success of the project. The selection criteria should involve meetings for the owner to be able to determine the extent to which proposers are willing to collaborate.

Table 2: Sample evaluation and scoring methodology

Procurement Approach	Experience and Capabilities		Organization, Management and Safety	Project Approach	Fee and Rate Proposal
	Design-builder	Key Personnel			
Single-Step					
RFQ	40%	30%	15%	15%	0%
Two-Step					
RFQ	40%	40%	20%	0%	0%
RFP	40%	30%	15%	15%	0%

5.1.5 Balanced collaborative contract

An important tool that must be well crafted to meet the requirements of the PDB project is the contract. The owner must establish equitable construction contract terms and conditions including performance guarantees before receiving initial proposals. The contract should use language that is understandable to the parties and encourages collaboration and communication among stakeholders. The contract should provide a fair process that facilitates and expedites the review and resolution of potential changes as well as adjustments in the contract price and time. It should also allow a dispute resolution process that promotes the prompt identification and resolution of disputes at the lowest possible level of hierarchy within the parties' organizations. Due to the collaborative nature of PDB any contract that favors one party over another has a high potential to fail.

5.1.6 Project packaging

An effective tool that promotes cost and schedule certainty is project packaging. By breaking the project into different packages, it allows progressive estimates, which are more manageable, and enable the project team to control cost during the design phase. Owners may have standard packages for similar projects that are based on the main trades involved in the project.

5.1.7 Open book pricing

Open book pricing is a tool that should be used to achieve an agreed-upon cost and a price for the construction effort to proceed (Clark 2017). The packaging and progressive GMP allows open book accounting and design to progress, leading to minimized risk and reduced hidden contingencies (Balis 2011). Open book pricing is effective because it provides transparency and develops trust between project team members (West, Gransberg and McMinimee 2012).

5.1.8 Continuous evaluation

Continuous evaluation is an effective tool that creates an awareness of the decisions made with outcomes and help review project status and issues. As the project progresses, it is important for the project team to meet regularly to evaluate the performance of the project. Project documentation during the evaluation is used to maintain ongoing, verifiable statistics to promote PDB, like savings in constructability and innovation, and also to record changes in project cost estimates as design advances.

The aim of the effective tools is that, if applied appropriately, should lead to the performance of PDB in terms of meeting owner's aspirational goals of minimizing schedule, pricing below budget and performing beyond the project quality requirements.

6 CONCLUSIONS

The literature review and comparison with the PDB cases have identified a number of effective PDB tools that are essential to the successful performance of PDB projects. The study also addressed the differences between PDB and DB, the benefits of PDB, and the challenges to a successful PDB delivery. The following conclusions are drawn from the above analysis:

- PDB is a new method with limited research that allows the owner to hire the design-builder solely on qualifications.
- PDB leverages the benefits of DB where one contractor is selected for both design and construction, and the benefits of CMAR where the owner has input and control over the preconstruction phase.
- The effective tools for successful performance of PDB project include owner education, risk assessment criteria, project selection criteria, proposal evaluation criteria, balanced collaborative contract, project packaging, open book pricing and continuous evaluation.

Although PDB has numerous advantages, public owners should be cautious when deciding on using PDB because they may not have the authority to use qualifications-only procurement. The major contribution of this paper is that the results and review provide the foundation to facilitate further research and applications for both academia and industry stakeholders by highlighting the key tools of PDB.

This study is limited in the sense that the results are mostly founded on literature review. It is recommended that further studies involving interviews and surveys of project stakeholders is conducted to further validate these identified tools and their impact on project performance.

7 REFERENCES

Al Khalil, M.I. 2002. "Selecting the Appropriate Project Delivery Method Using AHP." *International Journal of Project Management* 469-474.

Alleman, D, D Papajohn, D Gransberg, M El Asmar, and K Molenaar. 2017. "Exploration of Early Work Packaging in Construction Manager/General Contractor Highway Projects." *Transportation Research Board: Journal of the Transportation Research Board* 68-75.

Alpert, Mark, and Peter Tunnicliffe. 2011. *Water Design-Build Council.* Accessed 2019. http://waterdesignbuild.com/wp-content/uploads/Whats-Progressive-about-DB-Alpert-Tunnicliffe.pdf.

Architect. 2016. *DC Water Headquarters.* https://www.architectmagazine.com/project-gallery/dc-water-headquarters.

ASCE. 2012. *Quality in the Construction Project: a Guide for owners, Designers, and Constructors -3rd Edition.* Reston, VA: American Society of Civil Engineers.

Awezec, John, John Doller, and Peter Hughes. 2013. *Procurement Documents for Progressive Design-Build Projects.* Accessed 2019. http://waterdesignbuild.com/wp-content/uploads/Procurement-Documents-for-Progressive-DB-Mar-2013.pdf.

Balis, J. 2011. "Alternative Project Delivery." *2011 CMGC Peer Exchange.* Salt Lake City, Utah: Federal Highway Administration .

Brown and Caldwell. 2017. "Progressive Design-Build." Accessed 2019. http://tablerockpartners.com/wp-content/uploads/2017/05/PROGRESSIVE-DESIGN-BUILD-BASICS.pdf.

Clark, Leofwin. 2017. *The Principles Of Open-Book Pricing.* Accessed 2019. http://info.waterdesignbuild.com/blog/the-principles-of-open-book-pricing?

Clark, Leofwin. 2016. "What's So "Progressive" About Progressive Design-Build?" *Water Design-Build Council.* Accessed 2018. http://info.waterdesignbuild.com/blog/whats-so-progressive-about-progressive-design-build-0.

Corey, Geoffrey. 2016. *Design-Build Institute of America.* Accessed 2019. http://viewer.zmags.com/publication/41353926#/41353926/26.

Culp, Gordon. 2017. *What is Progressive Design-Build?* Accessed 2019. https://smithculp.com/2017/03/progressive-design-build/.

DBIA. 2015. *Best Design-Build Practices.* Design-Build Institute of America. Accessed 2019. https://dbia.org/wp-content/uploads/2018/05/Best-Practices-Federal.pdf.

DBIA. 2017. *Progressive Design-Build: Design-Build Procured with a Progressive Design & Price.* Design-Build Institue of America. Accessed 2018. https://dbia.org/wp-content/uploads/2018/05/Primer-Progressive-Design-Build.pdf.

DBIA. 2013. *Universally Applicable Best Design-Build Practices.* Design-Build Institute of America. Accessed 2019. https://dbia.org/wp-content/uploads/2018/05/Best-Practices-Universally-Applicable.pdf.

DBIA. 2018. *What is Design-Build?* Accessed 2019. https://dbia.org/what-is-design-build/.

FMI. 2018. *Design-Build Utilization Combined Market Study.* Design-Build Institute of America. https://dbia.org/wp-content/uploads/2018/06/Design-Build-Market-Research-FMI-2018.pdf.

Gates, Stephen, Jason Sheck, Holly Streeter-Schaefer, and Mark Alpert. 2017. "Standard Form of Contract for Progressive Design-Build." *Design-Build for Water/Wastewater Conference 2017.* Minneapolis,MN: Design Build Institute of America.

Gransberg, Douglas, and Keith Molenaar. 2004. "Analysis of Owner's Design and Construction Quality Management Approaches in Design/Build projects." *Journal of Management Engineering.* doi:10.1061/(ASCE)0742-597X(2004)20:4(162).

Gransberg, Douglas, and Keith Molenaar. 2019. "Critical Comparison of Progressive Design-Build and Construction Manager/General Contractor Project Delivery Methods." *Transportation Research Record: Journal of the Transportation Research Board.* doi:10.1177/0361198118822315, 2019.

Haskell. 2014. *How Progressive Design-Build Saves the City of Warner Robins Millions.* Jacksonville, FL: Haskell Construction. Accessed 2019. http://www.haskell.com/media/10676/warnerrobins-case-study_2014.pdf.

Kora, Philip, Wendy Barrot, Bryon Wood, Jill Jamieson, and Rich Atoulikian. 2017. "Structuring the Procurement Phase of a Progressive Design Build Project to Meet a Rapidly Approaching Permit Deadline: A Case Study With Great Lakes Water Authority." *Proceedings of the Water Environment Federation WEFTEC 2017.* Water Environment Federation. 3672-3680.

Lopez del Puerto, C., E. Craigie, and D. Gransberg. 2016. "Construction Cost Certainty Versus Construction Savings: Which is the Correct Approach?" *Transportation Research Board 95th Annual Meeting.* Washington, DC: Transportation Research Board.

Loulakis, Michael. 2019. *Progressive Design-Build: Basics, Benefits, Draw Backs and Procurement.* Accessed 2018. http://constructionclaims.com/Products/2017ProgressiveDesignBuild.aspx.

Loulakis, Michael, and Peter Kinsley. 2017. *Progressive Design-Build; A Design-Build Done Right Primer.* Design-Build Institute of America. Accessed 2019. https://www.leanconstruction.org/wp-content/uploads/2018/04/Progressive_Design_Build_Primer.pdf.

Molenaar, Keith, and Bryan Franz. 2018. *Revisiting Project Delivery Performance.* Construction Industry Institute. Accessed 2018. https://dbia.org/wp-content/uploads/2018/11/Cost_Performance_Research-CII_Pankow2018.pdf.

Parkinson, Robynne Thaxton, and Geoffrey W Neumayr. 2018. "Progressive Design-Build Basics." *Design-Build Conference & Expo.* New Orleans, LO: Design-Build Institute of America.

Raisbeck, Peter, Ramsay Millie, and Andrew Maher. 2010. "Assessing Integrated Project Delivery: A Comparative Analysis of IPD and Alliancing Contracting Procurement Routes." *26th Annual ARCOM Conference.* Leeds, UK: Association of Researchers in Construction Management. 1019-1028.

Shrestha, Pramen, and James Fernane. 2016. "Performance of Design-Build and Design-Bid-Build Projects for Public Universities." *Journal of Contsruction Engineering and Management.*

Smith, Currie & Hancock. 2015. *Smith, Currie & Hancock's Common Sense Construction Law: A Practical Guide for the Construction Professional.* 5th. Edited by Thomas Kelleher, John Mastin and Ronald Robey. Hoboken, NJ: John Wiley & Sons.

West, Nicola, Douglas Gransberg, and James McMinimee. 2012. "Effective Tools for Projects Delivered by Construction Manager–General Contractor Method." *Transportation Research Record: Journal of the Transportation Research Board* 33-39.