

REVISITING PROJECT DELIVERY PERFORMANCE

**New benchmarks for unit cost, delivery speed, cost
and schedule reliability.**



Revisiting Project Delivery Performance

Does the design-build delivery system still outperform the alternatives?

BACKGROUND

Twenty years ago, the Construction Industry Institute (CII) published a report titled, “A Comparison of U.S. Project Delivery Systems,” which benchmarked the performance of design-bid-build (DBB), construction manager at risk (CMR) and design-build (DB) projects. The report examined data from over 350 projects of varying size, sector, complexity and location that were completed in the mid-1990s. The analysis revealed that DB projects outperformed both CMR and DBB in terms of unit cost, cost and schedule growth, and all metrics relating to the speed of delivery. These results had a profound impact on how projects were delivered in the construction industry. In the decades since this seminal report, our industry has changed and there has been considerable interest in updating the benchmarks for contemporary projects.

SUMMARY

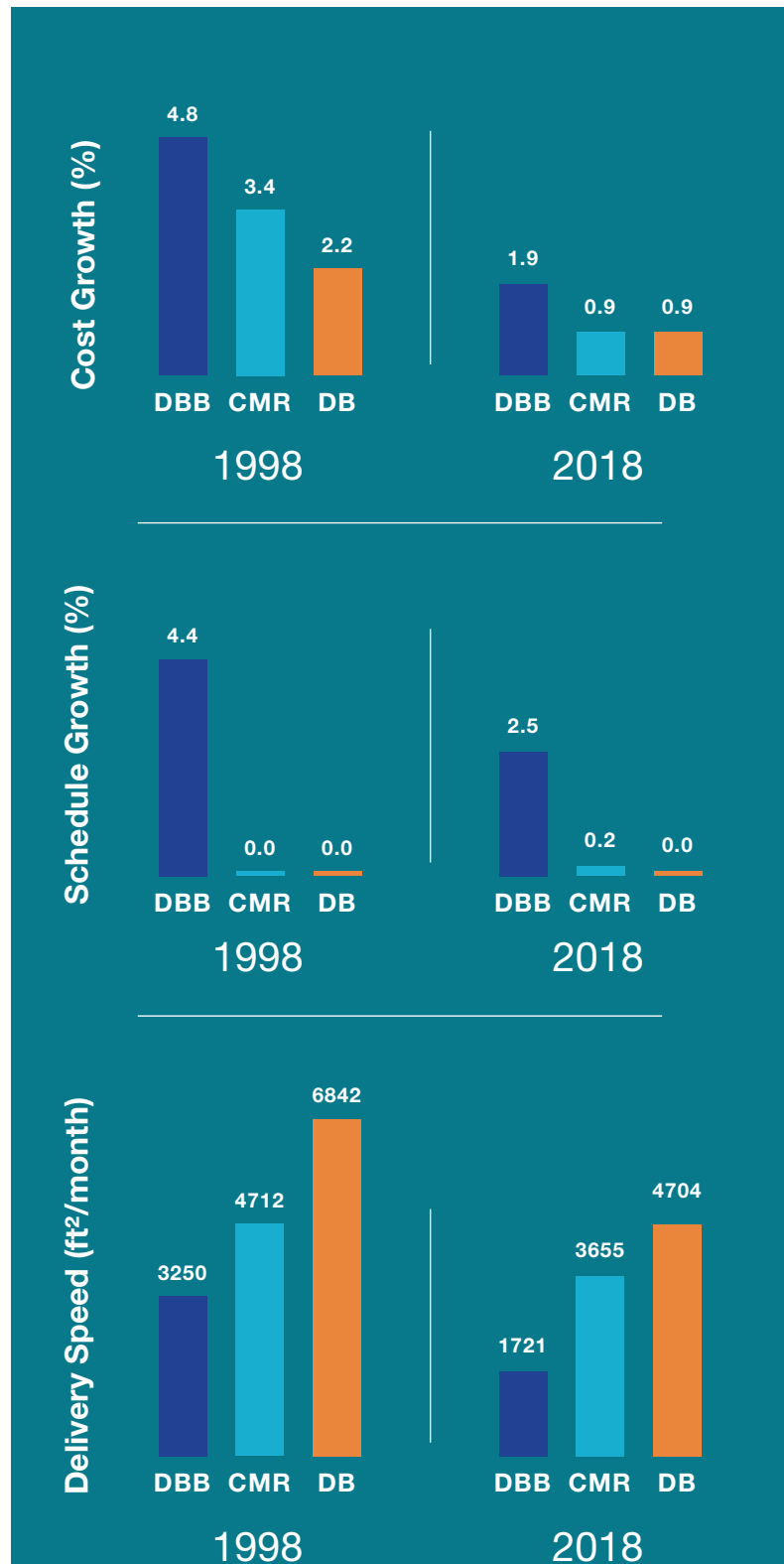
Our study updated the median performance benchmarks for project delivery systems using a new sample of 212 contemporary projects. A comparison of these results to the 351 projects used in the 1998 CII benchmarks is shown in **Figure 1**. **After 20 years, DB projects are still delivered faster and with greater reliability in cost and schedule performance.** These median results are highly consistent with the average performance of each project delivery system that we calculated through regression modeling.

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Figure 1: Median Performance Comparisons for 1998 CII and 2018 CII/Pankow Projects



METHODS

Detailed project information was collected using a survey questionnaire. A total of 212 projects were returned and verified for accuracy: 53 of which were DBB, 79 were CMR and the remaining 80 were DB. Sixty two percent (62%) of these projects were publicly funded and thirty-eight percent (38%) were privately funded. All projects were completed between 2008 and 2013 and represented a variety of building uses, including:

- Light industrial
- Heavy industrial
- Multi-story dwelling
- Simple office
- Complex office
- High technology

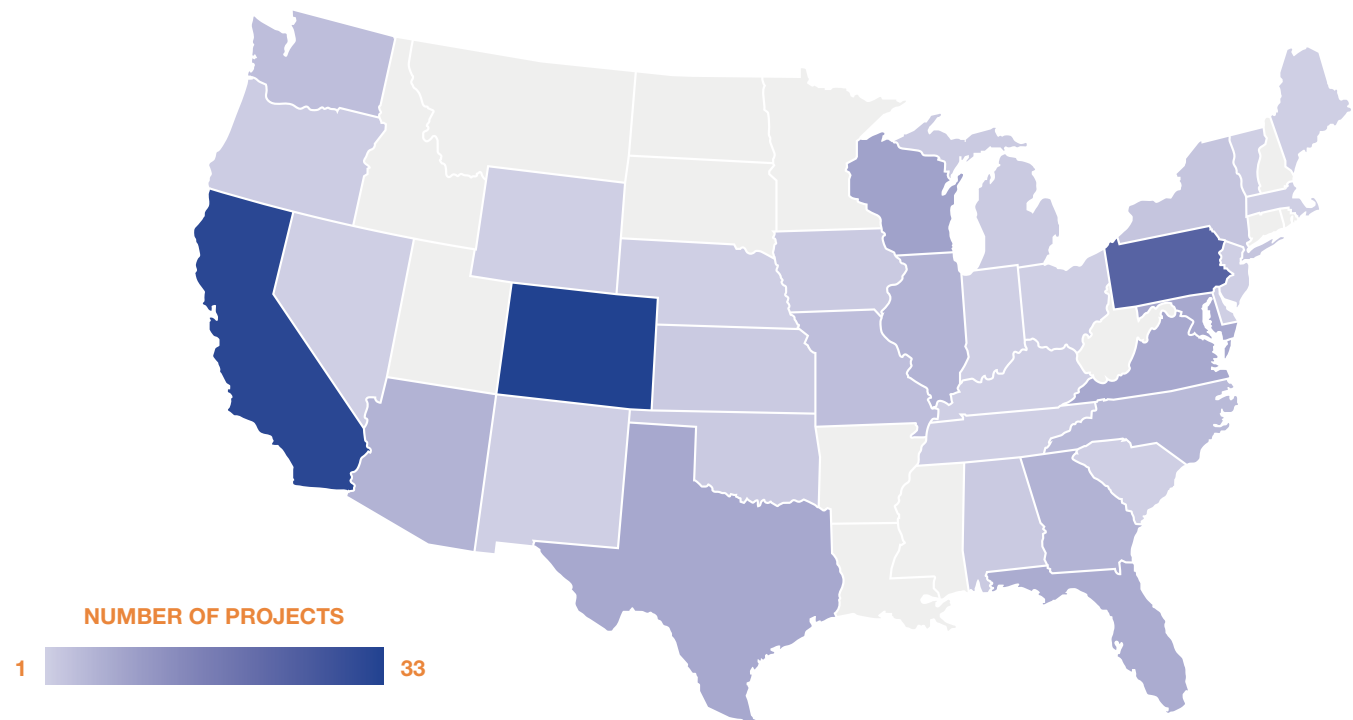
Buildings ranged in size from 5,000 square feet to over 1 million square feet, with approximately 60% being less than 200,000 square feet. The unit cost to design and construct these projects ranged from \$50 per square foot to over \$1,200, with 55% reporting less than \$400 per square foot. The projects were geographically distributed across the U.S. and not concentrated in any specific region (See Figure 2).

In addition to the median performance analysis, a subset regression analysis was performed for each measure of project performance: *unit cost*, *cost growth*, *schedule growth*, *construction speed* and *delivery speed*.

This analysis identified, in equation form, the set of key project variables that explained the greatest amount of variation in each measure of project performance. These equations were then used to calculate the average performance expected for projects delivered under each project delivery system.

To provide additional certainty in our results, case studies were conducted on 9 of the best performing projects and 7 of the worst performing projects. Each case study consisted of semi-structured interviews with the survey respondent to understand how key project variables contributed to each project's performance. We also documented lessons learned from each project to inform a set of recommendations for future projects.

Figure 2: Distribution of Projects Across the U.S.



AVERAGE PERFORMANCE

In addition to median benchmarks, the 1998 CII study used regression analysis to calculate and compare the average performance of project delivery systems. Using the same method, our average performance results are highly consistent with the median benchmarks and offer greater confidence in the comparison. Design-build was the best performing project delivery system in terms of both cost and schedule performance. On average, when compared to other project delivery systems in our sample:

Cost Performance

- DB projects are 1.9% less expensive than CMR on a cost per square foot basis and 0.3% less than DBB.
- DB projects see 2.4% less cost growth than CMR and 3.8% less than DBB.

Schedule Performance

- DB projects see 3.9% less schedule growth than CMR and 1.7% less than DBB.
- DB projects are 13% faster than CMR during the construction phase and 36% faster than DBB.
- From design through final completion, DB projects are delivered 61% faster than CMR and 102% faster than DBB.

COST RESULTS

With respect to unit cost and cost growth in our sample, DB has the best performance (See **Table 1**). These findings are consistent with the 1998 CII benchmark, however, the performance gap between project delivery systems has narrowed. On average, projects using DB are expected to cost 1.9% less per square foot when compared to CMR, and 0.3% less when compared to DBB. Similarly, DB projects are expected

to average 2.4% less cost growth than a comparably scoped project using CMR and 3.8% less cost growth than a project using DBB. The most surprising difference between the 1998 CII and current benchmarks was in the cost performance of CMR. When compared to DBB, CMR is now expected to cost 1.6% more per square foot and have 1.4% less cost growth on average.

Table 1: Cost Performance Comparison

Performance Measure	DB vs. CMR	CMR vs. DBB	DB vs. DBB	R ²
Unit Cost	1.9% less	1.6% more	0.3% less	99
Cost Growth	2.4% less	1.4% less	3.8% less	22

Note: R² is the percentage of the variance in each performance measure predicted by variables in the regression model. A higher R², up to a maximum of 100%, provides greater certainty in the benchmark.

For **unit cost**, the following conditions have the most impact in reducing the cost per square foot of the completed project:

- Higher team chemistry among the Owner, designer and builder (GC, CM or design-builder)
- Open book contracting terms, such as a cost plus a fee with a guaranteed maximum price (GMP)
- Lower initial contracted unit cost

For **cost growth**, the following conditions are the most influential in controlling design and construction costs throughout the delivery process:

- Use of a DB project delivery system
- Higher team chemistry among the Owner, designer and builder (GC, CM or design-builder)
- Smaller gross square footage of project
- Open book contracting terms, such as a GMP
- Earlier involvement of the builder

SCHEDULE RESULTS

Design-build was the best performing project delivery system in terms of schedule growth, delivery speed and construction speed (See **Table 2**). Compared to the 1998 CII benchmark, the differences in schedule growth across project delivery systems is tightening, while the gap in delivery and construction speeds is widening. Projects using DB are expected to have 3.9% less schedule growth than a comparable project

using CMR and 1.7% less schedule growth than a project using DBB. On average, DB projects are delivered 13% faster during construction and 61% faster from design through final completion when compared to CMR projects. Even more disparate, DB projects are delivered 36% faster during construction than DBB and 102% faster over the entire project duration.

Table 2: Schedule Performance Comparison

Performance Measure	DB vs. CMR	CMR vs. DBB	DB vs. DBB	R ²
Schedule Growth	3.9% less	2.2% more	1.7% less	21
Construction Speed	13% faster	20% faster	36% faster	88
Delivery Speed	61% faster	25% faster	102% faster	89

Note: R² is the percentage of the variance in each performance measure predicted by variables in the regression model. A higher R², up to a maximum of 100%, provides greater certainty in the benchmark.

For **schedule growth**, the following conditions are the most influential in controlling the duration of the design and construction process:

- Participation of the designer and builder (GC, CM or design-builder) in project goal-setting
- Earlier involvement of the builder
- Lower project complexity
- Private funding source
- Simpler foundation systems, such as slab-on-grade

For **construction speed**, the following conditions are most responsible for increasing the rate of completion of the construction scope, from notice to proceed to final completion:

- Use of a DB or CMR project delivery system
- Larger gross square footage of the project
- Higher initial contracted unit cost

For **delivery speed**, the following conditions are most responsible for increasing the rate of completion of the entire project, from design initiation to final completion:

- Use of a DB or CMR project delivery system
- Larger gross square footage of the project
- Higher initial contracted unit cost



BEST PERFORMERS

Across the case studies of the most successful projects, there were two recurring themes:

- The Owner placed a high emphasis on creating a relational project culture
- Repeated use of the same designer and/or builder (GC, CM or design-builder)

Each Owner had a different approach to shaping the project culture. One Owner, in particular, made their expectations clear during the first meeting. They challenged each member of the design and contractor’s teams to not tolerate arguments or unprofessionalism, be willing to express their opinion and to treat each other fairly. Another Owner described a constant drive for greater accountability and one project successfully implemented periods of co-location that began during the schematic design phase.

The majority of Owners on the best performing projects had worked alongside either the designer or the builder, or both, on prior projects. Because of these prior working relationships, they were more comfortable communicating and, specifically, more willing to share challenges or problems encountered on the jobsite with other team members.

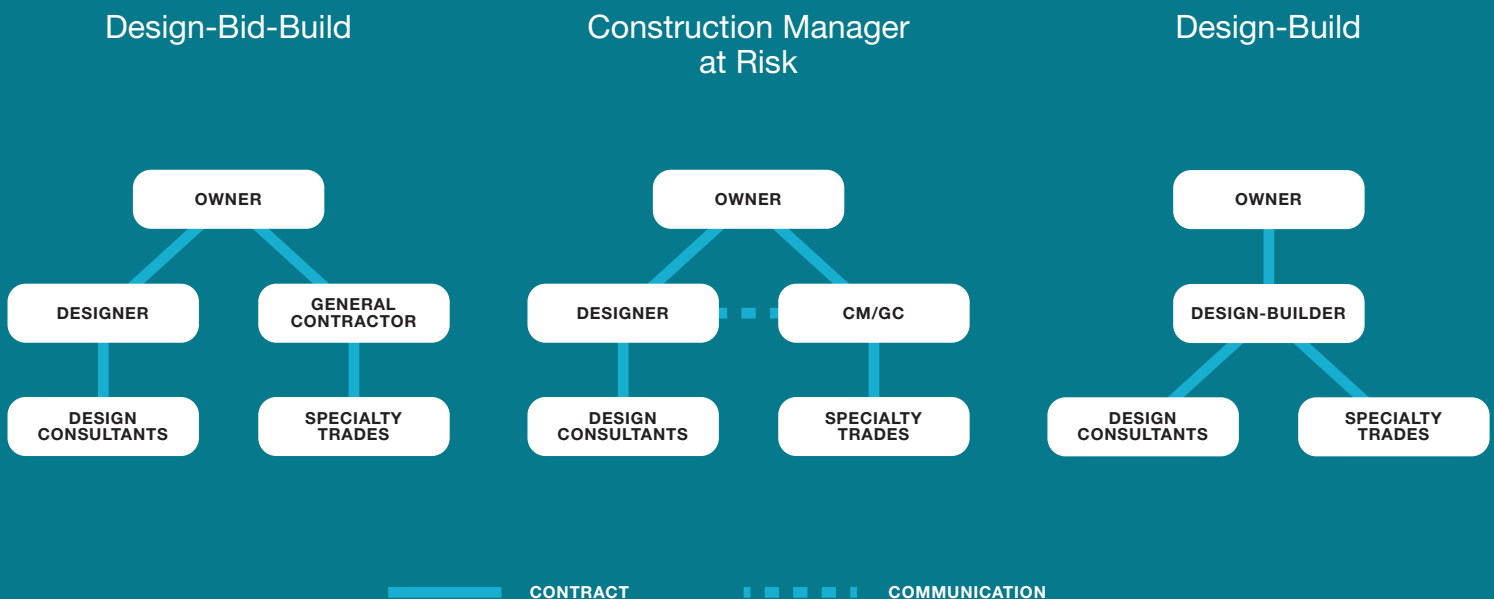
WORST PERFORMERS

Across the case studies of the least successful projects, three themes emerged:

- Lack of experience with the project delivery system or project management in general
- Poor communication between the Owner and the builder
- Understaffing or turnover within the Owner, designer or builder’s organization

Inexperienced project managers were frequently cited as the underlying cause of poor planning and inconsistent quality of installed work. In one case, the project manager for the contractor was new to the company and assigned to a project with tight deadlines. He had limited experience and, as a result, managed reactively to current problems, losing sight of the overall schedule. Staffing was also a challenge on some of the worst performing projects. On one case, understaffing placed a heavy workload on members of the project team and forced long hours. On another, frequent turnover meant that few team members retained a complete understanding of the project. The result in both cases was increased stress and animosity among the Owner, designer and builder.

Figure 3: Project Delivery Systems



RECOMMENDATIONS

Over the past 20 years, the average delivery speed for DB projects has increased, while still providing a lower cost per square foot and greater reliability in cost and schedule performance. Through a more detailed examination of the best and worst performing projects, we identified several common themes. The following are recommendations derived from those themes that can be applied, regardless of the project delivery system, to improve the likelihood of a successful project.

Bring the Team Together Early

Owners who seek early involvement, not only of the primary builder, but also of key DB or design-assist specialty contractors, realize more successful projects. Engaging the core project team members in the design process, before advancing beyond the schematic design phase, is critical to garner the full value of construction input and to begin building a cohesive project team.

Develop a Relational Project Culture

Owners who create a culture of trust within a project team have a higher probability of success. They can begin building relationships of trust through qualifications-based procurement and open book contracting.

The use of the same designer and builder on multiple projects, as opposed to low-bid selection on a project-by-project basis, can jump start a project culture by carrying forward existing relationships.

Communicate Expectations

Early team involvement and a relational project culture provide an opportunity for exceptional communication. The most successful projects use this opportunity to set clear expectations at the onset. Treating project goal-setting as a team activity with the Owner, designer, builder and key specialty trades ensures team alignment. Similarly, co-location is an essential tool on complex projects to facilitate communication and manage expectations throughout the process.

Engage in Succession Planning

The least successful projects in this study experienced disruptive turnover in key team members from the Owner, designer and/or builder's organizations. While some level of turnover is unavoidable, the teams that employ qualified project managers and actively plan for departures have a higher likelihood of success. This means developing a deep understanding of the roles and responsibilities of each other team member.



ACKNOWLEDGEMENTS

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ADDITIONAL RESOURCES

The Owner's guide to maximizing success on integrated projects. (2016). Leicht, R., Molenaar, K., Messner, J., Franz, B. and Esmaeili, B. Available for download at: projectdelivery.weebly.com

Project delivery systems: CM at risk, design-build, design-bid-build. (1998). Sanvido, V. and Konchar, M. The Construction Industry Institute, RT-133.



A learning organization with a wealth of knowledge and information, CII is unique in the engineering and construction industry.



Charles Pankow Foundation encourages industry collaboration and original research that provides practical and immediate benefits to design and construction teams.

