A Case Study Analysis of the Kentucky Transportation Cabinet’s Design/Build Pilot Projects

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A Case Study Analysis of the Kentucky Transportation Cabinet’s Design/Build Pilot Projects
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Final Research Report

A Case Study Analysis of the Kentucky Transportation Cabinet's
Design/Build Pilot Projects

by

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Design/Build Qualitative and Quantitative Analysis via Case Study Analyses of Kentucky Transportation Cabinet’s Design/Build Pilot Projects
The current economic climate has forced transportation agencies to evaluate opportunities to save money. One possible opportunity lies in Design/Build (DB) delivery. In 2006, with the approval of the Kentucky General Assembly, The Kentucky Transportation Cabinet selected ten projects to be developed through the Design/Build method. DB delivery offers many attainable advantages, the most notable being expedited delivery. The research described herein presents a case study of these DB pilot projects in order to capture lessons learned on the use of the DB delivery method on future projects. In order to determine which projects are suitable for DB delivery, a scorecard was developed based upon factors observed over the course of the DB pilot projects. Another important aspect of the DB pilot projects was their cost, it was believed their costs were much higher than a comparable design/bid/build (DBB) projects. However, after a thorough cost analysis, it was determined that the DB projects cost the Cabinet only an estimated three percent more than comparable DBB projects. The DB pilot projects have had mixed results. Several recommendations are provided that will assist agencies with DB project selection and successful management of DB projects.

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EXECUTIVE SUMMARY

The purpose of this report is to investigate the effectiveness of design/build project delivery. The Kentucky Transportation Cabinet (KYTC) has historically used design/bid/build (DBB) as their primary project delivery method. Language was provided in the budget during the 2006 General Assembly allowing the KYTC to use a maximum of ten design/build (DB) pilot projects in 2007 and 2008 (KYTC 2006).

In order to determine whether design/build is a feasible form of project delivery future for KYTC projects, a quantitative and qualitative analysis was performed on the performance of the before mentioned pilot projects. The qualitative analysis involved investigating each DB pilot project and discovering underlying factors that affected each project’s success as well as how effective DB delivery has been when compared to DBB delivery. The quantitative analysis involved exploring multiple avenues of data analysis to evaluate an array of project performance factors. The findings will assist KYTC in future DB project selection.

Results of the case studies indicate that there is a cost premium of using the DB delivery method, but the premium typically results in accelerated overall project delivery. Furthermore, the DB teams were found to be effective in coordination utility relocations and right-of-way acquisitions, when these functions were allowed to fall within their scope of work. While many of the DB pilot projects did experience cost growth, the percentage of the cost growth was comparable to what DB projects have experienced in other states. Overall, the studies provides the following recommendations:

1. DB project delivery has its place in the construction industry and for KYTC. The projects best suited for DB delivery should have a strong need for expedited delivery since DB projects are typically completed faster but at a premium for increase in cost in the project’s delivery.

2. KYTC should continue to ensure that the criteria used to select a DBT are transparent, objective, and readily understood by the KYTC personnel involved in the selection process.

3. The scorecard that has been developed as part of this study can be a good tool for the KYTC to predict the success of a project if awarded using DB project delivery method.
4. While DB projects that required minimal utility relocation, permitting, and ROW acquisition typically did better, the case studies did find that DBT were effective when these issues were placed directly under their control by allowing them to better coordinate construction activities and resources required to address these concerns.

5. When utility relocation is required, the relocation work should be included in the DB contract whenever possible to allow the DBT to have direct control over the utility relocation activities.

6. While DBT were found to be effective in handling permitting and ROW issues, the Cabinet should continue assisting the DBT in permitting and ROW acquisition as much as possible.
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1.0 INTRODUCTION

1.1 Introduction

State highway agencies are increasingly under pressure to improve project performance, complete projects faster, and reduce the cost of administering their construction programs. In response, the industry is turning to alternative contracting methods such as best-value procurement to assure project quality and enhance performance. In essence, best-value procurement incorporates construction contractor selection process factors, which along with price, seek to improve project performance or achieve other specific project goals.

The Kentucky Transportation Cabinet (KYTC) selected ten projects to be delivered using the Design-Build delivery method, however one was later canceled due to budgetary constraint. Projects selected are to have been determined to be categorical exclusions (CE) or having received a finding of no significant impact in accordance with NEPA. In addition, there are expected to be minimal right-of-way and utility issues. The KYTC surveyed several states practicing design-build and reviewed AASHTO materials related to design-build as part of developing their initial procedures. The KYTC is interested in capturing data and information regarding the implementation performance of the initial set of design-build projects.

This report includes tracking all nine design-build projects through the process from announcement to operation and provide recommendations about when the Design-Build method could be used on future projects.

1.2 Design-Bid-Build Project Delivery

The traditional form of construction project delivery is design-bid-build (DBB) (AASHTO 2008). The basic methodology behind DBB is as follows: 1) the owner hires a designer to create a project’s plans and specifications or has a design completed in-house; 2) once design is complete, the project is released for bidding; and 3) once a contractor is selected, the project is built. For projects using the DBB delivery method, the design is fully complete before the contractor bids the project. Another characteristic of the DBB delivery method is that there has historically been little communication between the different parties involved,
specifically between the designer and the contractor. This communication disparity is further perpetuated by the contracts that bind the parties; there is one contract between the owner and the designer, and a separate contract between the owner and the contractor.

1.3 Design/Build Project Delivery

Design/Build (DB) project delivery is a contract method where the designer and builder, which traditionally work separately under DBB, work together under one contract with the owner. By definition, DB is “an integrated delivery process where the responsibility for design and construction are held by one entity” (Hinze 2000), the design-build-team (DBT). The DBT can either be a single company with engineers/designers and contractors in-house or a joint venture between a design firm and a contractor.

1.3.1 Comparison of Design-Bid-Build and Design/Build

One difference between DB and DBB is the ordering of the project stages. DBB is end-to-end oriented as indicated by Figure 1.1. Concept planning is the first phase, followed by engineer selection, preliminary design, final design and project clearances, contractor selection, and finally construction. Each stage is carried out to completion in series before the next stage begins. With DB, time savings are incurred due to construction overlapping final design and project clearances¹ and because there is not a separate selection process for a designer/engineer. The overlapping stages in DB allows design to be completed while construction progresses. Time savings are one of the foreseeable advantages for DB delivery, and proof of time savings has been recorded by numerous other agencies. DB projects completed under the Federal

¹ Project clearances refer to all non-design elements that must be completed before construction begins, i.e. environmental permits, right or way, or utility relocation.
Highway Administration’s SEP-14 process demonstrated an average fourteen percent time savings when compared to a DBB schedule for the same project. Additionally, the Florida Department of Transportation recorded a thirty seven percent time savings on their first eleven DB projects (AASHTO 2008). Table 1.1 below highlights the differences between DB and DBB project delivery with regard to roles and responsibilities of each party.

Initial cost savings to the agency can be an advantage with DB delivery. With DBB delivery, the design is complete before construction begins. However, it was previously illustrated that there is no intensive up front design completed for DB projects. Therefore the initial costs associated with DB are limited to request for proposal (RFP) creation, initial design, historical soil data collection, bid analysis, and possibly the cost of stipends (AASHTO 2008).

Another advantage to DB delivery is that the schedule can be fixed earlier in the process. Since the design is not yet complete when the schedule is fixed, one could question the schedule’s accuracy. However, the AASHTO Guide for Design/Build Procurement states that DB has been shown to yield less schedule growth than DBB. This is likely due to DB’s ability to allow the DBT to innovate during construction, which helps avoid delays and change orders (AASHTO 2008).
As previously mentioned, the cost saving benefits for DB projects are difficult to measure. Since the design is not complete when the project is bid, the DBT will likely include more contingency in their bid, and one way to do that is by increasing the unit costs and quantities. It has also been mentioned that the costs may be higher as a result of a premium being paid for DB project delivery (AASHTO 2008), but the cost differences may also be reflective of fewer firms bidding on the project in comparison to DBB projects. Alternatively DB projects tend to have shorter durations than DBB projects, therefore one could argue that savings in road user costs provides enough costs savings to bring the costs of the project into a more competitive arena with DBB.

There is also an earlier fixed budget with DB, because the project is bid before it is fully designed. As shown in Figure 1.1, the budget will be fixed for DB after the DBT has been selected and before substantial design has begun; whereas with DBB, the budget is not fixed until the design is finalized and a contractor has been selected. DB contracts are usually lump
sum and there tends to be less cost growth because of fewer change orders in comparison to DBB projects (AASHTO 2008). Fewer change orders on DB projects are typically considered the result of increased integration of construction and design experience, thereby improving the project’s constructability, during project development. Proof of less cost growth on DB projects compared to DBB projects was reported by FHWA (2006) when it reported that a sample of DB projects experienced a 3.2 percent cost growth compared to 36 percent for a comparable sample of DBB projects. Also, the Florida Department of Transportation also reported a 2 percent cost reduction with a sample of DB projects compared to 9 percent increase for a comparable sample of DBB projects (AASHTO 2008).

1.3.2 Transfer of Risk

DB projects involve a transfer of risk from the agency to the DBT. Risk associated with design issues, environmental approval and permitting, right-of-way, local agency, utility issues, railroad issues, construction, acts of God, differing or changed site conditions, and warranty may be transferred (AASHTO 2008).

The risks with design issues are traditionally the responsibility of the agency with DBB. However, DB removes most of that risk from the agency and places it onto the DBT. The primary design risks with which an owner agency addresses with DB projects are usually limited to scope, design criteria, performance measurements, and basic configuration (AASHTO 2008).

Environmental approval and permitting can be, at least, partially transferred to the DBT. The nature of those permits is one where it names which party needs to be responsible for obtaining the permit. However, if a permit names the agency as the responsible party, the DBT may still hold the risk if the permit requirements depend upon and directly impact the construction schedule (AASHTO 2008).

Normally during DBB projects and even some DB projects, the agency maintains the responsibility of acquiring right-of-way. However, there are situations during DB delivery where it can be advantageous to transfer the risk to the DBT. By requiring the DBT to acquire
right-of-way, money can be saved by acquiring only the necessary parcels. But it can also be advantageous for the agency to have at least some hand in the process because they are in a better position to appraise, negotiate, and purchase right-of-way (AASHTO 2008).

### 1.3.3 DBT Procurement

Legislations at the federal and state levels allow the use of best-value selection strategies that include price, schedule, quality, and other factors when deemed to be in the best interests of the agency. Common DBT procurement is either one or two steps. In a one step method, interested bidders submit their qualification and past performance along with a technical proposal. The agency ranks the bidders according to the established criteria and awards the project to the highest ranked bidder. In the case of the two step method, the interested bidders are initially asked to submit a description of team qualifications, past performances, resumes of key personnel, organizational charts and other information relating to the team’s qualifications. The agency then short-lists three bidders (typically) on the basis of weightings of the selection criteria. In the second step, the short-listed bidders are asked to submit a technical proposal with a price and innovative design ideas. The agency then ranks the bidders according to the established criteria and awards the project to the highest ranked bidder (ASCE 2007). **One valuable lesson learned in the DB selection process is to maintain clear and objective criteria throughout the DBT selection process.** A recent case between Brayman Construction Corporation v. Commonwealth of Pennsylvania shows the importance of this need when the court ruled against the Pennsylvania Department of Transportation (Penn DOT) after Brayman Construction sued claiming that the DB selection process was not fair. One factor cited in the court’s ruling in the case was that various individuals with Penn DOT that testified during the suite provided different explanations about how DBT were ultimately selected on DB projects (ASCE 2011).

AASHTO has provided six suggestions for agencies procuring a DB project (AASHTO 2008). The following suggestions were meant to aid in creating a procurement method that will allow the most qualified team to win and to avoid bid protests. Additionally, they were developed based on several cases where the award was successfully protested due to unclear or overly subjective evaluation:
1. Select design-build teams based on a two-step process where a limited number of design-builders are short-listed;
2. Clearly state the evaluation criteria and weight given for each item and ensure that the evaluation team uses them;
3. Clearly state the requirements of the RFP including what will be considered a non-responsive proposal;
4. Do not seek from design-builders the number or dollar amount of changes on past projects constructed by them;
5. Give equal opportunity in the second stage for each short-listed team to converse with representatives of the public agency's evaluation team to clarify their proposal and any of the requirements of the RFP; and
6. Provide candid feedback and a stipend to unsuccessful proposers.

1.3.4 AASHTO Project Guidelines

Based on experiences of state transportation agencies that have used the DB delivery method, AASHTO identified four project guidelines that help determine whether a project is suitable for DB project delivery (AASHTO 2008). They are as follows:

1. New alignments, widening, rehabilitation, and reconstruction;
2. Projects greater than $10 million in value;
3. Projects that can utilize best-value procurement; and
4. Projects with no more than 25 percent design completed by the agency.

Along these same lines, AASHTO also created a list of reasons why to select a project for DB delivery (AASHTO 2008), which include:

1. A compressed schedule is required;
2. Schedule certainty is required;
3. Early cost certainty is required;
4. The project scope is well defined;
5. The project has complex constructability issues;
6. The project is unique and the agency has limited applicable experience.
7. Project quality can be defined though minimum design;
8. Opportunity for innovation exists; and
9. Minimal third party risks exist.

The items listed above are characteristics that can be fulfilled more readily by using DB delivery. Thus if a project possesses the above characteristics, choosing DB would, in theory, help to make the project more successful by satisfying its needs.

Based on experiences of state transportation agencies, AASHTO also identified project characteristics that would not work well with DB project delivery (AASHTO 2008). They are as follows:

1. Projects that require a completed design for accurate pricing;
2. Project financing is uncertain;
3. Projects involving already completed design for permits or third party issues;
4. Project risk to the agency, such as that related to subsurface conditions, has not been adequately addressed;
5. The project includes third party issues that are not manageable for the design/builder;
6. Projects involving sensitive environmental issues; and
7. Projects involving a scope or geographic location that may not generate adequate competition.

DB would not be the best delivery option for a project whose design must be complete for accurate pricing, since only a minimal amount of design is complete when the bid is submitted. When a DB project’s financing is uncertain, it may not be worth the additional risk to use DB, since committing funds to a DB contract requires funding a project through both design and construction. A project whose design must be complete for permits or third party issues is not well suited for DB delivery since design is not complete until later stages of construction. Sensitive environmental issues usually translate into a large amount of stringent permitting, which in turn could cause delays to construction on a DB project. Finally, DB projects do potentially involve a smaller pool of qualified firms or joint-ventures that have both the design
and construction expertise to complete the project. Therefore, an agency should determine that adequate competition does exist for a successful and competitive bid process to occur.

1.4 Conclusion

Public agencies across the country are pursuing the design-build project delivery method to expedite projects, and numerous transportation departments are currently using DB for highway construction. Kentucky has awarded nine design-build projects in order to understand its viability as an improved method of project delivery. Previous research has identified certain project characteristics that will help make design-build a successful procurement strategy and they include: a well defined project scope, a shared understanding of the project scope between the owner and the design-build team, adequate owner staffing, and an established budget, however, there are certain other factors and issues that will relate specifically to Kentucky and need to be identified. This report documents a systematic process of tracking design-build projects from procurement through design-build stages to completion using standardized case study and survey methods. The report also documents lessons learned and recommendations for design-build program improvement.
2.0 SCORECARD

2.1 Introduction

Saving money and expedited completion of highway projects are the main goals of the highway agencies. That does not mean that every project would be a good candidate for design-build procurement. Previous research has identified several important project characteristics, e.g. minimal right-of-way, minimal utility relocation, minimal environmental concerns, and complex constructability issues that will make design-build a successful procurement strategy. Even though many of these generalized project characteristics define a design-build project candidacy well, there may be other project characteristics that can have specific project interests or business requirements. Moreover, identifying weights of the above project characteristics can be another agency challenge. This chapter introduces a scorecard method to help the Kentucky Transportation Cabinet (KYTC) identify projects that would be suitable candidates for design-build procurement.

2.2 Development of the Scorecard

A scorecard was developed to assist the KYTC in future decisions whether a project should be developed through design-build procurement. The selection criteria for this scorecard are gathered from AASHTO, literature review of other states DB selection criteria, KYTC suggestions based on its own recent experience with DB, and case studies of KYTC’s current DB projects. The scorecard is a point based system and has three broad categories. The score card provides a predicted success score for a given project; the higher the score, the more likely the project will be successful if the DB delivery method is selected.

The score card includes three levels:
1. Level 1 – Project Scope;
2. Level 2 – Contract Condition; and
Level 1 addresses project characteristics such as construction type, cost, and scope of the project—basic features that are important for DB project success. Level 1 includes a total of 20 points with 5 points for each project criterion. Level 2 includes project characteristics such as availability of funds, opportunity for innovation, utilization of best value procurement, minimal third party risks, and expected market competition for the DB contract. A total of 30 points are stipulated for this level with equal weight for each criterion. In order to identify selection criteria that have the most adverse impact on the potential benefits of DB procurement, a case study of KYTC’s current DB projects was performed and the following reasons were identified as significant sources of major delays and cost overrun:

1. Five out of the first seven DB projects involve major delay due to utility relocations
2. At least three projects incurred delay due to environmental permitting; and
3. Delay due to right of way dispute

In order to address the above issues, Level 3 was formulated to assess potential project characteristics along these lines. Level 3 includes a total of 50 points equally divided by each of the criterion as categorized under existing project issues. The format of the scorecard and different criteria are shown in Table 2.1.

### 2.3 Predicted Project Success

The score card is completed by selecting criteria on the score card that are relevant to the project under question. For example, if the project’s estimated cost is more than $10 million then the second box of the Level 1 should be checked and it will account as 5 points. Similarly other boxes are checked for specific project criteria, if applicable. Next, scores for each level are calculated by multiplying the number of checks with each box’s weight point and summed to calculate the total score (see Table 2.1 for an example). The total score signifies the likelihood of project success if the project is awarded using DB project delivery. The maximum possible score is 100 points. The higher the total score the higher the probability of DB project success. Table 2 shows the summary of the predicted success score for all nine DB projects awarded by KYTC since 2007.
### Table 2.1: Design/Build Scorecard with Sample Scoring

![Design/Build Scorecard Table]

#### 2.4 Measured Project Success

The scorecard provides an estimated or probable success of the project. However, the true success of a project delivery method depends on two measurable factors to project success – schedule growth and cost growth. Cost growth is measured using the percent difference between...
Table 2.2: KYTC Design/Build Projects’ Predicted Success Scores

<table>
<thead>
<tr>
<th>DB Project Number</th>
<th>Predicted Success Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>72.5</td>
</tr>
<tr>
<td>2</td>
<td>87.5</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>71.25</td>
</tr>
<tr>
<td>5</td>
<td>72.5</td>
</tr>
<tr>
<td>6</td>
<td>57.5</td>
</tr>
<tr>
<td>7</td>
<td>75</td>
</tr>
<tr>
<td>8</td>
<td>83.75</td>
</tr>
<tr>
<td>9</td>
<td>72.5</td>
</tr>
</tbody>
</table>

actual cost and original bid cost. Similarly, schedule growth is measured using the percent difference between scheduled and actual project completion. A significant portion of a project’s success relies on both schedule and cost growth being either zero or negative. These factors are limited in their accuracy since the original schedule and cost are estimates based on a minimal amount of design. One of the most important features of DB project delivery is that it expedites project completion as well as reduces project cost. Therefore, both cost and schedule growth were considered to measure the success of DB projects.

Other factors that affect project success are design and construction, permitting, right of way, and utilities. For the purposes of this report, these factors will be known as project performance factors (PPF). These PPFs were created based upon each of the case studies. Design and construction refers to any innovative techniques employed, ease of construction, and any unforeseen conditions involving construction that occurred. Permitting deals with all permits that were required and the process completed to satisfy the conditions of the permits. ROW concerns the process of acquiring all land necessary, both temporary and permanent, for construction of the project. Utilities refer to the utility relocation process on the projects. Project success relies on each of these factors happening smoothly and without delay. Accordingly, the PPFs have been included in the project success calculation. Each of the factors was ranked from 0 to 2; 0 meaning there were major delays associated with that specific factor; 1 means there
were minor delays; and 2 refers to a factor that has caused no delay. The rankings were determined by the researchers based upon their knowledge of each project and the associated data.

Based on the cost and schedule growth and PPF, a DB project success score was determined for each project. Fifty points were stipulated for PPF because of their significant importance on DB project success. PPF scores for all nine DB projects are shown in Table 2.3. A study by AASHTO showed that 54% of all projects eventually cost more than their respective original award amounts, based on 26,500 projects from 20 states. However, 81% of the same projects did not exceed more than 10% above the original award (AASHTO 2007). In terms of schedule, 47% of the sample AASHTO sampled highway projects were completed behind schedule. The AASHTO study provides a rationale to stipulate weights for cost and schedule overruns. Cost growth was given a weight of 25 points. If the cost growth rate was between 0 and 10%, the project success score was credited 25 points; if cost growth was greater than 10% but less than 20% the project success score was credited 12.5 points; zero point is credited for a project with greater than 20% percent cost growth. The remaining 25 points were stipulated for schedule growth. If the schedule growth rate was between 1 and 1.5, the project success score was credited 25 points; if schedule growth was

<table>
<thead>
<tr>
<th>DB Project #</th>
<th>Design &amp; Construction</th>
<th>Permitting</th>
<th>ROW</th>
<th>Utilities</th>
<th>Total</th>
<th>Total Score Out of 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>7/8</td>
<td>43.75</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>6/8</td>
<td>43.75</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4/8</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>6/8</td>
<td>37.5</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>6/8</td>
<td>37.5</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>5/8</td>
<td>31.25</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>5/8</td>
<td>31.25</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6/8</td>
<td>37.5</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5/8</td>
<td>31.25</td>
</tr>
</tbody>
</table>
between 1.51 and 2 the project success score was credited 12.5 points; if project schedule growth rate was greater than 2 zero point is credited to the project success. For each DB project, cost and schedule growth and PPF were calculated. Individual scores were added, which is referred to as Project Measured Success. It should be noted that projects 7, 8, and 9 are currently under construction, so their PPF was determined based on their current and projected performance to completion. The project measured success scores are calculated and displayed in Table 2.4.

**Measured Success Equation:**

\[
\text{Cost Growth (25)} + \text{Schedule Growth (25)} + \text{PPF (50)} = \text{Total Measured Success}
\]

**Table 2.4: KYTC DB Projects’ Measured Success Score**

<table>
<thead>
<tr>
<th>DB Project #</th>
<th>Cost Growth Out of 25</th>
<th>Schedule Growth Out of 25</th>
<th>PFF Out of 50</th>
<th>Total Measure Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12.5</td>
<td>12.5</td>
<td>43.75</td>
<td>68.75</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>25</td>
<td>43.75</td>
<td>93.75</td>
</tr>
<tr>
<td>3</td>
<td>25</td>
<td>12.5</td>
<td>25</td>
<td>62.5</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>12.5</td>
<td>37.5</td>
<td>75</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>12.5</td>
<td>37.5</td>
<td>75</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>25</td>
<td>31.25</td>
<td>81.25</td>
</tr>
<tr>
<td>7</td>
<td>25</td>
<td>25</td>
<td>31.25</td>
<td>81.25</td>
</tr>
<tr>
<td>8</td>
<td>25</td>
<td>25</td>
<td>37.5</td>
<td>87.5</td>
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<tr>
<td>9</td>
<td>25</td>
<td>25</td>
<td>31.25</td>
<td>81.25</td>
</tr>
</tbody>
</table>

Later sections of the report will analyze the relation between the projects’ predicted and measured scores.

**2.5 Conclusion**
A systematic approach is shown in this chapter to develop a scorecard and measure project successes. The scorecard will act as a primary tool to identify whether or not a project would be a good candidate for design-build project delivery.

3.0 CASE STUDIES

3.1 Design/Build Pilot Projects Overview

During the 2006 general assembly, the Kentucky Transportation Cabinet (KYTC) was provided a budget that included language allowing the Cabinet to perform a maximum of ten projects using design/build delivery during the 2007-2008 Biennium. As a result, the Cabinet selected ten pilot projects to perform with design/build delivery. Quick facts about the projects can be found in Table 3.1-1 below and a map showing their locations are show in Figure 3.1. Project number 10 in McCreary and Whitley counties was canceled before construction began due to budgetary limitations. Consequently project ten was not included in the analyses.

Table 3.1 Design-Build Project Summaries

<table>
<thead>
<tr>
<th>DB Project Number</th>
<th>County</th>
<th>Road</th>
<th>Bid Amount</th>
<th>Project Length (miles)</th>
<th>Scheduled Duration (calendar days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB1</td>
<td>Fayette</td>
<td>KY 922/KY 1793</td>
<td>$11,025,931.51</td>
<td>3.462</td>
<td>633</td>
</tr>
<tr>
<td>DB2</td>
<td>Warren</td>
<td>US 231/KY 880</td>
<td>$14,178,451.38</td>
<td>2.128</td>
<td>560</td>
</tr>
<tr>
<td>DB3*</td>
<td>Taylor</td>
<td>KY 210/ KY 55</td>
<td>$18,724,570.93</td>
<td>2.29</td>
<td>1180</td>
</tr>
<tr>
<td>DB4</td>
<td>Whitley</td>
<td>I-75/KY 92</td>
<td>$6,799,019.20</td>
<td>&lt;1</td>
<td>850</td>
</tr>
<tr>
<td>DB5</td>
<td>Hardin</td>
<td>CS 2255</td>
<td>$3,150,434.75</td>
<td>1.022</td>
<td>344</td>
</tr>
<tr>
<td>DB6</td>
<td>Trigg</td>
<td>US 68</td>
<td>$50,283,912.92</td>
<td>8.041</td>
<td>1229</td>
</tr>
<tr>
<td>DB7*</td>
<td>Wolfe</td>
<td>Mountain Parkway</td>
<td>$45,623,391.00</td>
<td>4.336</td>
<td>1369</td>
</tr>
<tr>
<td>DB8</td>
<td>Cumberland</td>
<td>KY 90/KY 61</td>
<td>$53,167,078.16</td>
<td>5.5</td>
<td>626</td>
</tr>
<tr>
<td>DB9*</td>
<td>Garrard</td>
<td>US 27</td>
<td>$38,671,291.79</td>
<td>5</td>
<td>802</td>
</tr>
<tr>
<td>DB10</td>
<td>Whitley-McCreary</td>
<td>KY 92</td>
<td>-</td>
<td>CANCELED</td>
<td>-</td>
</tr>
</tbody>
</table>

*Currently under construction
The procurement strategy used by KYTC seemed to follow many of the important factors highlighted by AASHTO’s guide. All DBTs submitting bids were required to be comprised of a pre-qualified contractor and design consultant. The evaluation criteria and associated weighting was clearly stated as follows:

1. Lump Sum Bid (50 points)
2. Schedule/Capacity (30 points)
3. Innovation/Project Management (20 points)

Although KYTC reserved the right to reject bids, it was not clear what qualified a bid for rejection. Every team who was invited to submit a bid was invited to pre-bid meetings and given equal opportunity to converse with KYTC staff both via email and KYTC’s website. A stipend was provided to final bidders for projects 6-10 to cover the costs of preparing the design/build proposal.

Utility relocation strategy and right-of-way acquisition were the responsibility of the design/build team. It was stated in each RFP that the DBT should design the project with a minimum amount of utility relocation and ROW acquisition required. The realm of utility...
relocation and right-of-way acquisition is new territory to some of the contractors involved in the pilot projects. Under traditional DBB projects, utility relocation and right-of-way acquisition are coordinated and completed by KYTC before construction begins and the contractor is seldom involved. The cost of right-of-way and utility relocation was not included in the DB lump sum bids. However there were line-items that covered the costs of services rendered by the DBT for acquiring right-of-way and coordinating utility relocations.

Other unfamiliar tasks for the contractor included public involvement and permitting. KYTC required all projects to have public involvement no different from that of DBB projects. It was also the DBT’s responsibility to acquire all necessary permits. KYTC began the permitting process before the DBT was selected and construction began, which served as an aide to speed up the permitting process. Normally the schedule under DBB delivery would be more tolerant of time spent awaiting permit approval, however, since DB induces an accelerated schedule it was important to reduce the schedule impact of permitting.

Quality assurance and quality control (QA/QC) is an important aspect of any project. There were no notable differences between DBB and DB when it came to the method of QA/QC. There were, however, different mindsets that the KYTC QC managers became aware of. For a traditional DBB project, the contractor is paid based on in-place quantities; therefore the contractor with the balanced bid has no qualms about adding more rock, soil, or any other material. With a balanced bid, the contractors are eager to add quantities since it translates into more profit, consequently KYTC QC managers check quantities more closely to watch for overruns. Since the DB projects were let with lump sum contracts, it was not advantageous for the contractor to add more quantities because they were not paid extra for them. Subsequently, KYTC QC managers were less concerned about quantity overruns.
3.2 Design/Build Pilot Project 1

**Location:** Fayette County  
**DBT:** L-M Asphalt Partners LTD d/b/a ATS Construction & American Consulting Engineers  
**Road:** Newtown Pike/KY 922 & KY 1793/Ironworks Pike  
**Project length:** 3.462 miles  
**Number of proposals received:** 1  
**Stipend:** No  
**Bid amount:** $11,025,931.51  
**Estimated actual amount:** $12,669,873.37  
**Cost Growth:** +14.91 %  
**Number of change orders:** 11  
**Total Cost of Change Orders:** $1,643,550.01  
**Change Order Percent of Actual Contract Amount:** 12.98%  
**Reasons of Change Orders:** Utility relocations, Archaeological investigations, Fuel and asphalt, Undercut, Bridge revisions  
**Start date:** 10/6/06  
**Scheduled completion date:** 11/15/07  
**Actual completion date:** 6/30/08  
**Schedule Growth:** +56 %

3.2.1 Project Description

DB 1 involved construction and upgrades to Newtown Pike from I-75 to Ironworks Pike. The upgrades included minor alignment adjustments, added turning lanes, and widened shoulders. The DBT was instructed to employ context sensitive design and construction techniques.
3.2.2 Project Narrative

3.2.2.1 Design and Construction

DB I was completed on June 30, 2008. In order to properly fulfill KYTC’s expectations for the project, the DBT conducted numerous internal meetings to discuss how to most efficiently design the project to minimize costs and construction impacts. Public involvement meetings were held to gather important information and concerns. There was also a shareholders’ meeting at the horse park where it was learned that Brookledge Farm was concerned about how the maintenance of traffic would affect their operations. The DBT also met with University of Kentucky officials twice to discuss their concerns since the project impacted property used for research by the university. Their concerns were as follows:

1. Impact to a cemetery at an entrance to Maine Chance farm was the source of concern. UK officials had been in contact with the families of those buried there. There was concern about the impact of noise from construction and the new road to the residence on Main Chance and the breeding barns. Moving the road closer to the property was subsequently discouraged.

2. There are important no-till corn crops growing for research purposes. It is the longest growing patch of no-till corn in the United States. Disturbing these crops would have been detrimental to the ongoing research.

3. There were specimen trees on UK’s property. They were comfortable with replacing these with similar or compatible specimens. Replacing the dry stone masonry walls was approved by UK. The only stipulation was that temporary fences be installed during reconstruction.

4. There was concern also about erosion impacts to a stream that is traversed by a bridge that was reconstructed. It was requested by UK to improve the entrance to Main Chance, since it has almost no sight distance for drivers exiting the farm. Once the main stakeholders’ concerns were known, the DBT was able to design accordingly. The design of the roadway follows the typical section. The new alignment maintains the rolling character of the existing roads while also improving stopping sight distances. The DBT was able to adjust the alignment to miss the cemetery completely. The ROW

Design/Build Qualitative and Quantitative Analysis via Case Study Analyses of Kentucky Transportation Cabinet’s Design/Build Pilot Projects, 20
acquisition affected only four land owners. Each property’s entrance was reconstructed as part of the project. Relocation of irrigation facilities was required for part of UK’s property.

The impacts to the stream mentioned above were minimized. A team of stream mitigation experts developed a design that ensured the stream was not degraded after the new bridge was reconstructed. The new bridge was reconstructed to the west of the existing bridge to allow traffic to flow during construction. The guard walls that tie into the bridge have a special architectural treatment as part of the context sensitive design.

An arborist was brought in to evaluate the current foliage that exists around the projects. Based on his recommendations, the landscape team was able to provide a landscape design that meshed well with its surroundings. Another aspect to the landscaping was removing as few trees as possible. In addition, UK required specific types of trees not be planted for fear of negative interaction with their research farms. Since the new alignment was to the west of the existing roadway, traffic was maintained using the existing roadway for most of the project. Some areas called for temporary diversions. At times when embankment was being placed, traffic was reduced to one lane.

3.2.2.2 Permitting

KYTC performed baseline work to provide the DBT with all the necessary information to receive the proper permits. Section 404 and 401 permits were required and were received with no delay. Section 404 permits are part of congress’ clean water act that protects wetlands. Section 401 permits are required before section 404 permits can be obtained. Section 401 permits ensure water quality standards are adhered to.

3.2.2.3 Right of Way

The project’s design initially intended to widen the existing road only on the west side, which would only affect UK’s research farm, which was found not to be feasible without...
negative impacts. Therefore, the alignment was adjusted and affected only two additional land owners. There was also temporary easement required mostly for construction of dry stone masonry fences. The ROW acquisition process was completed quickly and without delay.

3.2.2.4 Utility Relocation

The DBT worked closely with the utility companies to minimize construction schedule impacts. The utility companies informed the DBT that they were not prepared for major relocation efforts in the time frame of this project. To help mitigate this problem, the DBT submitted their ROW plans one week from receiving the notice to proceed. UK ruled out shifting the alignment to avoid utilities.

There was one major delay lasting three to four months involving utility relocation, specifically a water line. The delay was the result of a much longer lead time for a special water valve than initially indicated by the utility company. Attempts were made to borrow valves from other projects but to no avail.

3.2.3 Synopsis

Although the original scheduled completion date was exceeded by 56 percent, the project, including design and construction, was finished in less than two years. Both the KYTC project manager and DBT representative agreed that the duration was much shorter than it would have been with DBB delivery.

The overall impact of DB delivery was positive. It allowed the construction to move quickly and deal with obstacles using innovation and expertise. There was a need for expedited delivery due to the World Equestrian Games that were played in Lexington in September 2010 and the safety concerns with the existing road. All stakeholders concerns were addressed and taken into account. The KYTC project manager said that he would have used DB delivery if he had to do the project again.
3.2.4 Project Photos

Figure 3.2-1: Context Sensitive Bridge and Guardrail

Figure 3.2-2: Graveyard that was Avoided

Figure 3.2-3: Turn Lane Added at Main Chance Farm entrance
3.3 Design/Build Pilot Project 2

**Location:** Warren County

**DBT:** Scotty's Contracting & Stone, LLC & American Engineers, Inc.

**Road:** Veterans Memorial Boulevard/US 231/KY880

**Project length:** 2.128 miles

**Number of proposals received:** 1

**Stipend:** No

**Bid amount:** $14,178,451.38

**Estimated actual amount:** $14,178,451.38

**Cost Growth:** 0.0%

**Number of change orders:** 2

**Total Cost of Change Orders:** $0.0

**Change Order Percent of Actual Contract Amount:** 0.0%

**Reasons of Change Orders:** Latex overlay and underrun of items

**Start date:** 11/27/06

**Scheduled completion date:** 6/9/08

**Actual completion date:** 6/9/08

**Schedule Growth:** 0.0%

### 3.3.1 Project Description

DB 2 involved the widening of US 231/KY 880, from US 68/KY 80 to US 231X, and the widening of KY 880, from KY 1435 to US 231X (US 231X denotes the alternate business route of US 231). The original roadway within the project limits was designed as a two lane initial, four lane ultimate highway with a forty foot depressed median. The new road is a five-lane highway.
### 3.3.2 Project Narrative

#### 3.3.2.1 Design and Construction

DB 2 was completed on June 9, 2008. Several obstacles surfaced while compiling the initial design. The original plans included discrepancies in the existing roadway alignments as shown on plan from the actual alignments that existed on the ground. The DBT resolved the issue through an iterative process and was able to provide specified geometrics for the project and make the transitions to the existing roadway possible. The DBT also held regular internal meetings to coordinate construction activities.

At approximately the same time that DB 2 was beginning, another project on an adjacent road (Russellville Road) was underway. The DBT felt that it was necessary to coordinate with the contractor on that project to minimize construction costs and avoid rework. By working with the contractor they were able to align systems with both projects, including both projects’ curb and gutter and storm sewer systems.

There were no delays on the project. There were two change orders. One change order involved reduction of quantities installed. It was found that the existing shoulders had an asphalt depth that exceeded that of the new road. Therefore, it saved time and money for the DBT to leave it in place. The DBT split the savings from this, with 80 percent going to KYTC and 20 percent going to the DBT. The second change order involved a latex overlay on a bridge and a deduction of unused items.

Maintenance of traffic (MOT) involved keeping original lanes open during widening then switching traffic to the newly widened portion in order to perform required work on existing portions. MOT was straightforward and caused no difficulties.
3.3.2.2 Permitting

There were no special environmental concerns. The typical erosion control plans, as well as nationwide permits for bridges and culverts, and Best Management Practices Plan for erosion and sediment control were used on the project.

3.3.2.3 Right of Way

Two parcels located at the intersection of US 68/KY 80 were acquired. All other portions of the project were constructed within existing right of way.

3.3.2.4 Utility Relocation

The utility relocations required for the project were minimal. Utility work involved lowering an encased waterline. A phone line that interfered with a turn lane was also relocated. The DBT was also proactive in dealing with the utility companies by administering meetings with the affected utilities in order to promote collaboration and sharing of requisite information.

3.3.3 Synopsis

The project had no major problems or delays. It finished within schedule and budget. There was no immediate need to complete this project; therefore there was a sense on the project that using DB delivery was not completely necessary. The original schedule was more than enough time to complete the project and allowed the contractor to pull manpower off this project to work on other ongoing jobs. However, the contractor created the schedule with contingency built-in. Since the utility relocations were minimal and right of way acquisition went smoothly, there was extra time in the schedule. When asked if he had to do the project over again the KYTC project manager said he would not use DB delivery. Although the project was a success, it may not have been the best utilization of funds since DB delivery has shown to be more expensive and because it was the opinion of the KYTC PM that expedited delivery was not necessary.
3.3.4 Project Photos

Figure 3.3-1: New Road with Multi-Use Path on Left

Figure 3.3-2: East End of Project
3.4 Design/Build Pilot Project 3

**Location:** Taylor County

**DBT:** Nally & Haydon, LLC & American Engineers, Inc.

**Road:** KY 210/KY 55

**Project length:** 2.290 miles

**Number of proposals received:** 1

**Stipend:** No

**Bid amount:** $18,727,442.97

**Estimated actual amount:** $18,728,853.04

**Cost Growth:** +0.02%

**Number of change orders:** 7

**Total Cost of Change Orders:** $1,410.07

**Change Order Percent of Actual Contract Amount:** 0.0075%

**Reasons of Change Orders:** Fuel & asphalt adjustments, Change from PG 76-22 to PG 64-22, Drainage modifications, Std. curb & gutter, Ride quality adjustment

**Start date:** 03/22/2007

**Scheduled completion date:** 7/1/09

**Actual completion date:** 11/30/2010

**Schedule Growth:** +162%

3.4.1 Project Description

This project entails widening KY 210 and KY 55. There are two segments of the project; one begins at KY 3183 and ends at US 68, while the other begins at KY 1625 and ends at US 68. The project calls for both sections to be widened to five lanes. The need for this project involves improving the capacity for KY 210 and KY 55 because of commercial and industrial developments.

---

2 As of 02/03/2011
3.4.2 Project Narrative
3.4.2.1 Design and Construction

The main concerns of the DBT were a USGS blue line stream, right of way dispute, and utility relocation coordination. Before the project began, the DBT thoroughly assessed the stream crossing and the adjacent wetlands in order to assure minimal impact to the areas. There was a short list of endangered species that may have been impacted by the project. The DBT made efforts to minimize construction impacts on these species.

The DBT left out replacement of concrete islands at an intersection in their original plans. Since this was their mistake, the DBT was required to redesign and were not issued a change order to make up for the extra cost.

There is a culvert located on the project whose ends were extended due to the widening. It was determined that the existing culvert was strong enough to remain intact, the ends just needed to be extended to accommodate the wider road. This saved time and money versus constructing a new culvert.

Maintenance of traffic consisted of limited excavations with temporary lane closures. The major concern with MOT was how phasing would affect signal installation. Public involvement consisted of several meetings with stakeholders and keeping the main stakeholders informed via a mailing list.

3.4.2.2 Permitting

Section 404 and 401 certifications had to be obtained by the DBT for this project. The process took longer than expected; however, it was overshadowed by extensive delays from utility relocations.
3.4.2.3 Right of Way

There was one right of way dispute that stemmed from a parcel that encroached on right of way. However, the dispute was resolved quickly and amicably through negotiation and minor plan revision. The majority of the right of way acquired was either permanent or temporary easement.

3.4.2.4 Utility Relocation

Utility relocation was the source of the major delay for this project. Before the project was awarded, the utility company agreed to allow the work to be let with the DB contract. Several days before letting, they decided they wanted to let the relocation of their water and sewer line for competitive bidding as part of a separate outside contract. They also wanted to perform independent design on the proposed utility relocations. KYTC and the DBT attempted to keep the utility relocation in the project, but the city of Campbellsville had the final say against it. When it was clear that nothing could be done in terms of putting the water and sewer relocation under the project contract, the DBT attempted to work with the utility contractor to expedite the process. The DBT tried to have the designer of the utility lines do either KY 210 or KY 55 completely before designing the other. Instead the designers worked on different portions of each route at the same time disallowing the contractor to do any substantial work on either section. There was a delay of 17 months to complete utility relocations.

3.4.3 Synopsis

The decision to let the water and sewer relocation as a separate contract had an unfortunate effect on the project. KYTC did everything possible but the lack of cooperation, which is a key parameter for DB project success, resulted in a 17 month delay. The project manager stated he would not have used DB delivery on the same project again, since the outside requisite work on utilities was performed outside the control of the DBT and largely negated any enhanced collaboration among project participants that is to be expected on DB projects. The project manager also stated that lump sum contract may not be the best option for DB project
delivery, which is because if the contractor saves money, he doesn’t share that with the Cabinet. He mentioned that the unit price bid would be a better option.

3.4.4 Project Photos

![Figure 3.4-1: Completed KY 55 Section with Five Lanes](image)

**Figure 3.4-1: Completed KY 55 Section with Five Lanes**
Figure 3.4-2: Extended Culvert near KY 55/KY210 Intersection

Figure 3.4-3: Gutter Construction in Progress near KY55/210 Intersection
Figure 3.4-4: Construction Going on KY210 Section
3.5 Design/Build Pilot Project 4

**Location:** Whitley County

**KYTC project manager:** Phillip Howard/Robert Perkins

**DBT:** Kay & Kay Contracting LLC & Vaughn & Melton Consulting Engineers, Inc.

**Road:** I-75/KY92

**Project length:** <1 mile (Interchange)

**Number of proposals received:** 2

**Stipend:** No

**Bid amount:** $6,799,019.20

**Estimated actual amount:** $8,177,867.14

**Cost Growth:** +6.21 %

**Number of change orders:** 11

**Total Cost of Change Orders:** $1,378,847.94

**Change Order Percent of Actual Contract Amount:** 16.86%

**Reasons of Change Orders:** Utility relocations, Addition KY 92/KY 2386 intersection, Landscape enhancement elimination, Fuel & asphalt adjustment Additional lighting and electrical repairs, Slope excavation

**Start date:** 08/09/2007

**Scheduled completion date:** 7/15/2008

**Actual completion date:** 8/14/2009

**Schedule Growth:** +67.16 %

3.5.1 Project Description

DB 4 involved the reconstruction of the interchange located at exit eleven on I-75 at KY 92. It has been made into a standard diamond interchange. Urban and rural typical sections were required. The project was designed to capacity to the interchange.

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3 Adjusted for scope increase
4 Adjusted for scope increase
3.5.2 Project Narrative

3.5.2.1 Design and Construction

There was a separate portion of the project, added by change order, which involved reconstruction of 10th street, which is less than one mile from the original project. That portion was added as a Hazard Elimination Project to alleviate traffic congestion from Cumberland College and other local traffic. Accordingly, 10th street was widened and dedicated turning lanes were added.

The original ramp design did not adhere to standard requirements, therefore the contractor had to redesign the ramp in accordance to AASHTO standards and tie into I-75 at their expense. The redesign lengthened the ramp by 400 feet and raised the elevation slightly to properly align it with I-75.

There was also a project delay attributed to the acceptability of an installed keystone retaining wall, the first of its kind for KYTC. The main issue stemmed from the differences between KYTC’s and the manufacturer’s recommendations for the gradation of the backfill material; KYTC had more stringent requirements. Ultimately, the issue was remedied by following KYTC’s standards.

Public involvement in the project was typical and was comprised of making the public aware of the construction. A major stakeholder concern for the project was maintenance of traffic, and restrictions placed on lane closures and allowed times for construction activity. However, the DBT worked through it with KYTC.

3.5.2.2 Permitting

There was no permitting required for this project.

3.5.2.3 Right-of-Way

All portions of the project including the 10th street portion were constructed on existing right-of-way.
3.5.2.4 Utility Relocations

There were utility relocations involved in the 10th street portion of the project, which warranted another change order to secure funding for the relocations. The DBT did not initially anticipate utility relocations. It was also not clear where the existing waterlines were located which resulted in delays during utility relocation work.

3.5.3 Synopsis

Soon after the project began there were questions regarding design standards, unanticipated utility coordination, and delays. The most significant source of delay involved the utility relocation. This project highlights the importance of clarity and communication. It also indicated how scope changes can have just as great an impact on DB projects as they can have on DBB projects.

3.5.4 Project Photos

Figure 3.5-1: Keystone Retaining Wall Under Construction
Figure 3.5-2: Completed Keystone Retaining Wall 1 Year Later

Figure 3.5-3: Widened Bridge

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3.6 Design/Build Pilot Project 5

Location: Hardin County
KYTC project manager: Gary Valentine/Paul Sanders
DBT: Gohmann Asphalt and Construction & Gresham, Smith and Partners
Road: CS 2255, Wilson Road
Project length: 1.022 miles
Number of proposals received: 3
Stipend: No
Bid amount: $3,150,434.75
Estimated actual amount: $3,410,241.55
Cost growth: +8.25%
Number of change orders: 4
Total Cost of Change Orders: $259,806.80
Change Order Percent of Actual Contract Amount: 7.62%
Reasons of Change Orders: Utility relocations, Fuel and asphalt, Sidewalk ramps
Start date: 5/21/2007
Scheduled completion date: 11/20/2007
Actual completion date: 5/02/2008
Schedule growth: +89.62%

3.6.1 Project Description

DB 5 involved the widening of Wilson road from 31W to the entrance of the Fort Knox Army Base. The road was widened to a three lane urban typical section, and a multi-use path was also installed. The need for the project focused on improving capacity on the road due to area development and expansions of the Army base.
3.6.2 Project Narrative

3.6.2.1 Design and Construction

DB 5 was completed in May of 2008. In order to minimize impacts to both local business parking and existing utilities, the road was widened to the east of the original centerline. The widening required the relocation of telephone poles from station 39+00 to the Fort Knox entrance. Pushing the alignment to the right and relocating the existing telephone poles increased the safety, placed new poles, and allowed the project to maximize usage of permanent easement. The maintenance of traffic plan was typical and did not cause problems or delays for the DBT.

Public involvement on the project involved partnering meetings with KYTC, Fort Knox officials, City of Radcliff leaders and the DBT. The meetings discussed current project status and schedule and were open to the public.

3.6.2.2 Permitting

There was a slight permitting issue at the beginning of the project, but it was remedied by KYTC before the RFP was sent out. The issue involved the habitat of the endangered Indiana Bat. KYTC agreed to pay into the Indiana Bat Conservation Fund, which allowed the DBT to work within the habitat outside of the dormant season.

3.6.2.3 Right-of-Way

The ROW acquisition process was expeditious and without delay. Since both Fort Knox and the city of Radcliff were supporters of the project, permanent easement for ROW was acquired straightforwardly with their help.
3.6.2.4 Utility Relocation

During their first utility meeting with the City of Radcliff Wastewater Department, the DBT learned that all gravity sanitary sewers on the project were vitrified clay pipe, which required extra care to excavate due to their brittle nature. Some portions of the system were labeled as abandoned on a survey, however it was determined that they were actually in use. The last factor uncovered during the meeting was the existence of a 6 inch force main and 8 inch force main with casing pipe at the intersection of Knox Boulevard and Wilson Road. A casing pipe was required to widen over the existing force main pipes.

It was found that the City of Radcliff pays Kentucky Utilities for installation, maintenance, and electricity for all of their roadway lighting. Kentucky Utilities also stated they would only maintain equipment that they have installed. Accordingly, the DBT was only responsible for installing conduit that was sufficient for Kentucky Utilities to construct their lighting facilities.

The impact to gas pipes was limited to conflicts with storm sewer pipes, which called for intermittent relocations. LG&E approved of allowing their gas lines to remain under pavement.

The Hardin County Water District #1 would not allow their water lines to be covered by pavement and also stipulated the pipes be no deeper than 5 feet and have at least 3 feet of cover. The DBT was responsible for design and relocation of the water lines.

Since the project was only 1.022 miles long, it was imperative that all utility relocations and ROW acquisitions be carried out as quickly and efficiently as possible. Any delays encountered would be magnified because the DBT would not have any other portion of the project on which to work. There was delay encountered involving utility relocation. Although the delay was caused by the utility company, it was explicitly stated that utility coordination was the responsibility of the DBT. Therefore, the DBT was made to pay liquidated damages for the delay, which caused the scheduled completion date to be surpassed.
3.6.3 Synopsis

The project was ultimately a success. There was a need to complete the project quickly, since Fort Knox had expansion plans and there were local developments in the project’s vicinity. On such a small project, any problem or delay encountered is magnified. There was a utility delay that delayed the completion date of the project that ultimately involved the contractor paying liquidated damages.

3.6.4 Project Photos

![Figure 3.6-1: North End of Project at Fort Knox Entrance](image)

Figure 3.6-1: North End of Project at Fort Knox Entrance
Figure 3.6-2: Local Businesses that were Avoided by Widening to the East

3.6-3: Stretch of Road Facing South Away from Fort Knox Entrance
3.7 Design/Build Pilot Project 6

Location: Trigg County
KYTC project manager: Everett Wilson/Michael Oliver
DBT: Rogers Group Inc. & QK4
Road: US68
Project length: 8.041 miles
Number of proposals received: 3
Stipend: Yes
Bid amount: $50,283,912.92
Estimated actual amount: $51,481,964.67
Cost growth: +2.38%
Number of change orders: 10
Total Cost of Change Orders: $1,198,051.75
Change Order Percent of Actual Contract Amount: 2.33%
Reasons of Change Orders: Utility relocations, Asphalt bases, New wage rate
Start date: 5/30/2007
Scheduled completion date: 9/30/2009
Actual completion date: 11/30/2010
Schedule growth: +49.88%

3.7.1 Project Description

DB 6 involves the widening of US 68/KY 80 in the Land Between the Lakes area. The project begins and ends at, but does not include, existing bridges in the east and west sides of Land Between the Lakes. The project widened the current two-lane road to a four lane divided highway. The project required a multi-use path. The need for the project aims to improve the capacity for the Land Between the Lakes Area while maintaining the natural beauty and tranquility for which the area is known.
3.7.2 Project Narrative

3.7.2.1 Design and Construction

DB 6 was completed on November, 2010. An environmental obstacle for the DBT involved flood plain mitigation. There were cuts and fills during this project below the elevation of the flood plain. The total volume of the flood plain was required to remain unchanged. Since there was more fill than cut affecting the flood plain, soil was moved out of the flood plain in other spots. The DBT acquired 3 parcels near the project and in the flood plain that was excavated to bring the flood plain volume to its original level. During the excavation of one parcel, the “do not disturb boundary” was breached and the excavation was stopped which caused a slight delay but did not affect the construction schedule.

There were several other environmental concerns, such as the habitats of resident bats and elk. Other environmental concerns included minimizing impacts to streams on the project. The DBT was able to minimize impact to six streams on the project through the use of retaining walls, slope changes, culverts, and channel lengthening. The DBT was also required to replace any wetlands that were disturbed by the project.

Other delays involved erosion control measures. Several initial erosion control methods were insufficient for certain areas of the project because large amounts of erosion were observed. The DBT employed different methods and materials to mitigate erosion. Additionally, this project’s funding relied upon affective erosion control. Inspectors sent to the site evaluated the erosion control measures and acceptability, and stimulus money from the federal government, that would keep the project funded, hinged on the results of the inspection. The project passed inspection and was funded through federal stimulus funds, which kept KYTC’s budgetary limitation from affecting the project.

Weather was also a source of delay. In particular, the January 2009 ice storm created large amounts of debris to be cleared before construction could resume.
The DBT has had to accommodate several design considerations, including context sensitive design. This included two bridges at the Trace road with architectural stone treatments. It also applied to any portion of the project viewable from the road. There are several camp grounds on the project which required entrances to be placed from the new road. Since noise abatement was a concern, the DBT planted a double staggered row of Virginia Pines to buffer the camp grounds from the road.

Maintenance of traffic was not complicated. Most of the eastbound lanes of the new project are on a completely new alignment separate from the existing road. Additionally, much of the new road is bifurcated, which allowed traffic to be routed onto one while the other is being completed.

A website was established to keep the public informed about the project and its progress. Radio updates were also broadcast, and numerous meetings with the public and other stakeholders were conducted as well.

3.7.2.2 Permitting

This project is located on state park land, therefore stringent environmental regulations applied. The major delays involved both individual and federal permits with the US Army Corps of Engineers. In order to help combat the anticipated permitting delays, the project was broken into three buildable units. Each unit was permitted separately in the hopes to begin working on portions of the project while awaiting permits for the others. Despite the DBT’s best efforts to reduce permitting delays, they were the main source of delay during the project. KYTC played a key role in minimizing permitting delays by beginning the permitting process before the project was let.

3.7.2.3 Right-of-Way

The only land acquired for this project was from the Forest Service. The project lies entirely in permanent easement belonging to KYTC, therefore no addition ROW was necessary.

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There are thirty-five locations which required temporary easements for reasonable construction of the project.

3.7.2.4 Utility Relocation

There are two utilities located on the project, electric and telephone lines. Large portions of each facility were relocated while other portions were located outside the permanent easement and require no relocation. To relocate the electric lines, the utility company agreed to allow the DBT to install underground conduit through which the utility subcontractor will install and connect the electric cables. The telephone lines were relocated using direct burial methods and the existing overhead lines were removed by the utility company. Most of the utility relocations did not interfere with construction.

3.7.3 Synopsis

Permitting issues and delays have been the main theme of this project. They were not, however, unexpected since the Land Between the Lakes area is a very natural and preserved environment and wildlife habitat. DB delivery still saved time in comparison to DBB delivery since construction on portions of the projects proceeded while other portions underwent permitting review and approval. Even though heavy environmental concerns and high anticipation of stream and wetland impacts made the project a less viable candidate for DB delivery, the resident engineer stated that he would still use the DB delivery because permitting issues with the Forest service and Corps of Engineers would have been very cumbersome under the DBB delivery method.
3.7.4 Project Photos

Figure 3.7-1: Context Sensitive Design

Figure 3.7-2: Completed East Bound Lane with Existing Road on Left
Figure 3.7-3: Culvert that will accommodate a through Bicycle way

Figure 3.7-4: New Context-Sensitive Bridges at Trace Road

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3.8 Design/Build Pilot Project 7

Location: Wolfe County

KYTC project manager: Steve Gunnell

DBT: Hinkle Contracting Corporation & HDR/Quest Engineers & The Walker Company of KY & Lochner Engineers and Planners

Road: Mountain Parkway

Project length: 4.336 miles

Number of proposals received: 1

Stipend: Yes

Bid amount: $45,623,391.00

Estimated actual amount: $45,998,571.055

Cost growth: +0.82%

Number of change orders: 3

Total Cost of Change Orders: $375,180.05

Change Order Percent of Actual Contract Amount: 0.82%

Reasons of Change Orders: Fuel and asphalt adjustment, roadway design fee

Start date: 9/15/08

Scheduled completion date: 12/1/2011

Actual completion date: 6/12 (projected)

Schedule growth: +14.45% (projected)

3.8.1 Project Description:

The project is located on the Mountain Parkway between mile points 43.1 and 46.2. The KY 15 interchange at Campton is also included in the project and will be reconstructed to be a fully directional interchange and allow the Mountain Parkway to have two lanes in each direction with a median. The purpose of this project is to improve capacity and safety on the Mountain Parkway and improve access for KY 15 to the Parkway.

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5 As of May 2011

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3.8.2 Project Narrative
3.8.2.1 Design and Construction

DB 7 is ongoing. There were two environmental concerns on the projects. The local water treatment plant reservoir is located directly next to a portion of the project. In order to protect this supply, the design calls for separation of roadway drainage using storm sewers, curb and gutter, and a filter/containment system for “first flush” scenarios. “First flush” scenarios represent a situation where a large amount of pollutants are washed from the roadway by rain. There is also Swift Camp Creek identified as a cold-water habitat that is affected by the project. Swift Camp Creek is being protected by the installation of a creek crossing, which insures that only clean stones go into the creek. Kentucky’s Division of Water and Corps of Engineers inspections will be done to ensure the creek is properly protected.

There are two structures on the project that are being replaced. One is a ramp from Hazard Road that spans over the east bound lanes of the Parkway and ties into the west bound lanes. The existing bridge provided the same access, but had a fractured critical member as a result of a likely existing hairline fracture in a steel member resulting in loss of flexibility in the affected member. The other structure is a crossing at Swift Camp Creek. The crossing will be comprised of two bridges, one for each direction of traffic. The existing bridge rests on two pillars, one of which has shifted. To prevent further movement of the pillar, concrete was cast over the pin connections to the bridge beams. The other existing pillar has been deemed structurally sound and will be left in place and used for the new west-bound bridge.

There were some initial concerns about maintenance of traffic because of the interchange at the beginning of the project, but the MOT in that particular area of the project has been sufficient. The other main concern of MOT will be shutting down a ramp to tie into a new bridge, everything must be done to avoid closing the Mountain Parkway. Flyers and message boards will be placed to alert people of the ramp closure and detours they may use.
At the beginning of 2009, the project was slowed due to state budgetary limitations. The construction schedule was not overly burdened by the slow down since it was during winter months. The slow-down has since been lifted and construction is on schedule. Public involvement has involved 2 public meetings and has been typical.

3.8.2.2 Permitting

The only delay incurred on the project has come from approval of roadway permits. Otherwise the permitting process was carried out efficiently and without problem.

3.8.2.3 Right-of-Way

The project was broken into 2 phases to help construction, ROW acquisition, utility relocation, and permitting move as efficiently as possible. There was some initial concern regarding mineral, oil, or gas leases on some parcels, however this issue never materialized into a delay. A barrier median throughout the project has allowed for minimal ROW to be required. Phase 1 ROW acquisition went smoothly and without delay. Phase 2 has encountered a couple setbacks in the form of two unsettled parcels. It is possible that the said parcels could move to condemnation. The issue with one parcel is not of a reluctant land-owner, but the fact that the listed owner is a minor on the deed and by Kentucky law it must go to condemnation for KYTC to purchase the parcel.

3.8.2.4 Utility Relocation

A portion of a fiber optic line owned by AT&T had to be relocated during construction. The line rested on private property and required twenty additional utility easements. AT&T took longer than expected to move the line, however no delay was incurred, since the DBT worked on other portions of the project while waiting. The DBT relocated the water and sewer lines themselves, which helped expedite the process. Representatives from the DBT have remained in contact with the utility companies via email and phone. There are currently 2 relocation plans awaiting approval.
3.8.3 Synopsis

The project had immediate safety issues that needed to be remedied as soon as possible; the ramp with the fracture critical member, the bridge with the shifted pillar, and the danger of the current road. DB delivery is proving to be the best choice for this project due to the accelerated schedule. All aspects of the project have gone relatively smoothly with a slight delay encountered when obtaining roadway permits. The KYTC project manager conveyed that DB delivery was the correct choice for this project.

3.8.4 Project Photos

Figure 3.8-1: The New Bridge that Spans over the East Bound Lanes of the Parkway and Ties into the West Bound Lanes
Figure 3.8-2: New Bridge that Replaced the Old Bridge with Fracture-Critical Member

Figure 3.8-3: Construction Crossing at Swift Camp Creek being Constructed
Figure 3.8-4: Stretch of Road with a New Median Barrier Wall
3.9 Design/Build Pilot Project 8

Location: Cumberland County
KYTC project manager: Mark Robertson
DBT: Joint Venture: ATS Construction/Gaddie-Shamrock and American Consulting Engineers. Elmo Greer & Sons, LLC and Palmer Engineering
Road: KY 90 & KY 61
Project length: KY 90: 14.113 mile stretch of various spot improvements; KY 61: 5.5 miles
Number of proposals received: 2
Stipend: Yes
Bid amount: $53,167,078.16
Estimated actual amount: $55,086,242.09
Cost growth: +3.61%
Number of change orders: 13
Total Cost of Change Orders: $1,919,163.93
Change Order Percent of Actual Contract Amount: 3.48%
Reasons of Change Orders: Utility relocations, KY 61 bridges, concrete work, Section C extension
Start date: 10/02/2007
Scheduled completion date: 12/01/2010
Actual completion date: 12/01/2010
Schedule growth: 0.00%

3.9.1 Project Description

DB 8 focused on widening and safety improvements to various sections of KY 90 and KY 61. The first 5.314-mile section of KY 90 involved shoulder improvements, reconstruction of curves, an additional lane for passing, and storm sewer improvements. The second section involved realigning the intersection at KY 90/KY 100 to the west to improve geometrics. A turning lane will also be added to KY 90 as part of this portion. The last 2.113-mile section of
KY 90 involves shoulder improvements, reconstruction of curves, geometric alignment improvements, and an urban section with sidewalks. The 5.5-mile KY 61 portion of the project involves realignment of the road with 2 lanes and 8-foot shoulders.

3.9.2 Project Narrative
3.9.2.1 Design and Construction

DB8 was completed in December, 2010. In order for the project to progress as fluidly as possible, the DBT broke it into six segments. The main goal of the DBT was to minimize relocations, ROW impacts, and utility relocations; each segment of KY 90 was designed with these goals in mind. Some segments were shifted to avoid community or historic site interference and other segments were shifted for stabilization and flood prevention purposes. The KY 60 segment was previously designed and approved by KYTC; this design was scrutinized by the DBT and found to be adequate. A slight adjustment was made by shifting an approach to improve safety of the intersection and guardrail performance. MOT was typical and caused no problems for the DBT or the public. MOT included flaggers around construction zones and periodical lane closures.

Public involvement was comprised of an initial meeting to notify people of the project and hear their concerns. Three ROW informational meetings were also held. In addition to the meetings, one of the companies in the DBT works in the area and helped to assess the public climate regarding the project.

3.9.2.2 Permitting

The permitting involved stream and wetland assessments, 401 and 404 permits, determination of mitigation needs, evaluation of threatened or endangered species issues. Minimizing stream impact was a major goal of the roadway design. There were environmental engineering consultants as part of the DBT who handled the permitting. With KYTC’s help in beginning the permitting process, it went smoothly and without delay.
3.9.2.3 Right of Way

Right of way acquisition went slower than expected; however no delay was incurred since the project has many segments on which work could be done while others were acquiring ROW. Since the DBT is handling the ROW acquisitions they are able to acquire them in the sequence that fits with their construction schedule. Additional ROW was purchased due to slope instability on KY 61 section.

3.9.2.4 Utility Relocation

The DBT hired a utility consultant to help expedite the utility relocation process. The consultant helped convince the utility companies to allow the DBT to handle the relocations as opposed to the utility companies’ own contractors. The utility companies obliged and the design and construction of all impacted utilities was let to bid. Subsequently, the DBT was able to work the relocations into their schedule. The waterline relocations were actually added by change order to the contract. The remaining utility relocations were coordinated though the District’s utility section.

3.9.3 Synopsis

The project completed on schedule with slight increase in cost growth. Despite the successful nature of the project, it is the opinion of those associated with the project that there was not an immediate need to have the project built. Therefore, it is believed among some of the project stakeholders that using DB, with its higher costs, was not the best decision. This particular project is a unique example among the pilot projects because every aspect of the project has been successful and aligned with accelerated delivery. However the KYTC project manager stated he would not use DB delivery on this project again since the project was not an immediate need.
3.9.4 Project Photos

Figure 3.9-1: Completed KY61 Section

Figure 3.9-2: Construction Going on KY90A Section
Figure 3.9-3: Construction in Progress on KY90A2 Section

Figure 3.9-4: Completed KY90C Section

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3.10 Design/Build Pilot Project 9

**Location:** Garrard County

**KYTC project manager:** Mark Walls

**DBT:** Elmo Greer & Sons, LLC and Geotech Engineering & Testing, Inc., The Allen Co., Inc. and HMB Professional Engineers, Inc. and GRW Engineers - Architects - Planners

**Number of proposals received:** 1

**Stipend:** Yes

**Road:** US 27

**Project length:** 5 miles

**Bid amount:** $38,671,291.79

**Estimated actual amount:** $39,195,612.796

**Cost growth:** +1.36%

**Number of change orders:** 5

**Total Cost of Change Orders:** $524,321.00

**Change Order Percent of Actual Contract Amount:** 1.33%

**Reasons of Change Orders:** Utility relocations, Commercial entrances, Fuel & asphalt adjustment, Culvert modification, ROW negotiation, KY 1845 turn lane

**Start date:** 8/18/2008

**Scheduled completion date:** 12/15/2010

**Actual completion date:** 8/30/2011 (projected)

**Schedule performance:** +30.51% (projected)

3.10.1 Project Description

DB 9 involves the widening and relocation of US 27 from south of Camp Nelson to fifteen hundred feet south of KY 34. The road will be a four lane road with 10 foot shoulders. The scope of this project was the most well-defined of any of the pilot DB projects. This project

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6 As of June 2011
had been in development for over twenty years, and the design was seventy five percent complete when it was let for bidding.

3.10.2 Project Narrative
3.10.2.1 Design and Construction

DB 9 is ongoing. Since the design was nearly complete when the project was let, the DBT’s responsibility involved checking the plans and making minor adjustments. It was discovered that the north end of the project required grade adjustments to balance the cut and fill. The said realignment saves both money and time. There is also a five hundred foot long culvert that has been redesigned to run around a hill instead of through it, thus improving the project’s constructibility and saving money. Maintenance of traffic has not yet been an issue to data since the project is on a new alignment that crosses the existing road at 3 spots and only one of those portions of the project have begun to date. There have been 5 change orders, neither of which involve scope changes. One was to add turning lanes at the entrance to a parcel of land affected by the project; the other was to reallocate funds.

This roadway was built through a civil war camp, Camp Dick Robinson. Archeology surveys were performed to clear the area. Also, the DBT added a special parking area with sidewalk and signs that highlights the historical significance of the area to the contract.

There were several geotechnical concerns because of many sinkholes over the course of the project. The DBT had to clean the sinkholes, place fabric, and then build a rock fill inside the sinkholes to a determined elevation so that water would be able to flow through the existing sinkholes. The culvert at Sta 361+29 was re-designed with three 15 degree bends to avoid substantial rock excavation, and it was changed from a standard culvert to an inlet controlled culvert to reduce construction costs.

There was a vague MOT in the plans, but due to the ever changing nature of this project, most traffic control issues have been determined in the field. Due to the experience of the contractor and the Department’s personnel, this has worked fine for this project.

There was one meeting with the public after the DBT was chosen to notify them of the project and give them an idea of which parcel would be affected.
3.10.2.2 Permitting

The permitting process was fulfilled without problem or delay mostly by KYTC before the project was let. The seventy five percent complete design was advantageous to the permitting process, since it allowed ample time for determination of which permits would be needed and application for those permits.

3.10.2.3 Right of Way

The ROW acquisition portion of the project is ongoing due to the vast amount of ROW required, a total of 83 parcels of lands were required for additional ROW. The DBT has acquired ROW according to the construction schedule. The project was divided into 7 buildable units to allow construction to progress without delay during ROW acquisition.

3.10.2.4 Utility Relocation

Utility relocation caused the most delays, with most of the delays attributed to communications of priorities between the DBT and utility companies. At one point, AT&T made priority to relocate a section on the South section of the project when the actual priority was on the North end. The 7 buildable units were also created to help maintain the construction schedule during utility relocation. Kentucky’s highest pressure gas line runs through the project at a point that required twenty feet of cut. It was initially believed that there was rock in the area which would require blasting, thankfully this was not the case and no blasting was needed. The new gas line has been placed and will be tied into the existing line during off-peak times of the year. Fiber optic lines on the project are being relocated and their relocation is occurring slower than anticipated without impacting the construction schedule.

3.10.3 Synopsis

At first glance, this project does not appear to be one that would thrive under DB delivery. Its design was nearly complete when the project was let, which would nearly eliminate
the time-savings from designing and innovating during construction. However, the KYTC project manager believed that DB delivery was the best delivery method for this project. This project has been discussed for over 30 years with multiple public meetings over the years. The KYTC project manager believes that ROW negotiations were easier to negotiate when property owners saw constructing activities beginning on the most southern portion of the project. Property owners clearly understood that the project was going to be built. The only concern of the KYTC project manager was the Cabinet is considerably paying more money to build it this way, but he believes that the added benefit of allowing the DBT to handle utility relocation and ROW acquisition, significantly benefited the construction schedule.

3.10.4 Project Photos

![Figure 3.10-1: Culvert Construction](image-url)
Figure 3.10-2: Section of New Road with Base Course of Pavement

Figure 3.10-3: Clearing and Grubbing and Excavation at 2/3 Complete
Figure 2.10-4: Roadway near Completion in one Section
3.11 Design/Build Pilot Project 10:

CANCELED DUE TO BUDGETARY LIMITATIONS

Location: McCreary-Whitley Counties
KYTC project manager: Joseph Mosley
DBT: Palmer/Elmo Greer & Sons, LLC
Number of proposals received: 3
Stipend: Yes
Road: KY 92
Project length: 8.625 miles
Bid amount: $66,400,000
Estimated actual amount: N/A
Number of change orders: N/A
Start date: N/A
Scheduled completion date: 6/30/11
Actual completion date: N/A
4.0 DATA ANALYSIS

4.1 Analysis of Predicted and Measured Project Success

As previously explained, each project’s success was measured using cost and schedule performance and project performance factors. Total scores from the scorecard were used to determine the predicted success of each DB project. The predicted success scores are compared to the measured success as shown in Table 4.1.

<table>
<thead>
<tr>
<th>DB Project Number</th>
<th>Predicted Success</th>
<th>Measured Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB1</td>
<td>72.5</td>
<td>68.75</td>
</tr>
<tr>
<td>DB2</td>
<td>87.5</td>
<td>93.75</td>
</tr>
<tr>
<td>DB3*</td>
<td>75</td>
<td>62.5</td>
</tr>
<tr>
<td>DB4</td>
<td>71.25</td>
<td>75</td>
</tr>
<tr>
<td>DB5</td>
<td>72.5</td>
<td>75</td>
</tr>
<tr>
<td>DB6</td>
<td>57.5</td>
<td>81.25</td>
</tr>
<tr>
<td>DB7*</td>
<td>75</td>
<td>81.25</td>
</tr>
<tr>
<td>DB8</td>
<td>83.75</td>
<td>87.5</td>
</tr>
<tr>
<td>DB9*</td>
<td>72.5</td>
<td>81.25</td>
</tr>
</tbody>
</table>

*Currently under construction

Design/Build Qualitative and Quantitative Analysis via Case Study Analyses of Kentucky Transportation Cabinet’s Design/Build Pilot Projects, 67
Figure 4.1: Predicted vs. Measured Success of the DB Projects

Figure 4.1 shows the relationship between the projects’ predicted success scores and measured performances scores. Obviously, a limited sample size of 9 project prevents any statistical analyses of the predicted versus the measured success of the projects. However, it is evident that the projects with a predicted score of 70 or more have higher measured success rates. Therefore, a predicted score of 70 could be a good benchmark indicator for DB project selection. The researchers suggest that projects with a predicted success score of 70 or below need to be scrutinized more thoroughly before selecting whether to use the DB project delivery method.

4.2 Unit Cost Analysis

The unit cost analysis was performed to determine whether the costs for the DB projects were higher than average. Higher costs are a possibility for the DB projects since the DBTs are assuming more risk. One may believe that higher costs are justifiable and can be interpreted as a
premium being paid for the advantages to KYTC, such as accelerated schedule. This premium will be addressed more thoroughly later in the data analysis.

To conduct this analysis, each project’s bid items were evaluated. The unit cost of each bid item was compared to its counterpart in KYTC’s 2006 or 2007 average unit cost data, depending on when the project was bid. Each bid items quantity was multiplied by its corresponding unit cost on both the bid document and KYTC’s historical average unit cost. Keeping in mind that lump sum items jeopardized the accuracy, all lump sum items were omitted from this analysis. However, the amount of lump sum omitted from each bid is shown for accountability purposes. Another note that should be made regards the calculated bid costs. They do not correspond precisely with the actual bid amounts on the documents, since many of the costs on the bids cannot be accounted for with unit costs. Examples of such items include but are not limited to design fees, right-of-way costs and services, and utility relocation costs and services. Although the bid costs do not correspond exactly, the main purpose of this analysis is to compare the unit costs of the bid with KYTC unit costs. Since the same quantities and bid items were used, the comparison will still be accurate.

The results of the analysis show the DB bid prices have an average of only 6.91 percent higher costs than the KYTC average. The results can be seen in Table 4. Since there is initial uncertainty and risks assumed by the DBT, quantities for bid items could be inflated to help counter the risk. There does seem to be consensus among the KYTC project managers as well as the DBT representatives that DB costs more than DBB. However, the unit cost analysis should not be disregarded. It provides a base-line estimate for the price comparison of the DB and DBB.
Table 4.2: Weighted Unit Cost Percent Differences with Lump Sums Omitted as of May 2011

<table>
<thead>
<tr>
<th>DB</th>
<th>Total w/KYTC avg.</th>
<th>Total Bid</th>
<th>Total Lump Sum Omitted</th>
<th>% Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB 1</td>
<td>$11,946,502.11</td>
<td>$8,969,513.00</td>
<td>$2,976,989.11</td>
<td>-24.92%</td>
</tr>
<tr>
<td>DB 2</td>
<td>$10,644,099.80</td>
<td>$12,825,695.90</td>
<td>$2,181,596.10</td>
<td>20.50%</td>
</tr>
<tr>
<td>DB 3</td>
<td>$13,733,785.99</td>
<td>$16,774,755.82</td>
<td>$3,040,969.83</td>
<td>22.14%</td>
</tr>
<tr>
<td>DB 4</td>
<td>$5,216,420.75</td>
<td>$4,612,218.56</td>
<td>-$604,202.19</td>
<td>-11.58%</td>
</tr>
<tr>
<td>DB 5</td>
<td>$2,002,766.33</td>
<td>$2,173,001.61</td>
<td>$170,235.28</td>
<td>8.50%</td>
</tr>
<tr>
<td>DB 6</td>
<td>$41,822,185.09</td>
<td>$42,401,587.15</td>
<td>$579,402.06</td>
<td>1.39%</td>
</tr>
<tr>
<td>DB 7</td>
<td>$27,915,080.87</td>
<td>$37,226,975.00</td>
<td>$9,311,894.13</td>
<td>33.36%</td>
</tr>
<tr>
<td>DB 8</td>
<td>$27,346,514.37</td>
<td>$32,964,291.57</td>
<td>$5,617,777.20</td>
<td>20.54%</td>
</tr>
<tr>
<td>DB 9</td>
<td>$34,113,382.01</td>
<td>$33,208,438.89</td>
<td>-$904,943.12</td>
<td>-2.65%</td>
</tr>
<tr>
<td>DB 10</td>
<td>$51,668,480.05</td>
<td>$52,599,487.82</td>
<td>$931,007.77</td>
<td>1.80%</td>
</tr>
</tbody>
</table>

AVERAGE 6.91%
4.3 Design Fee

It is estimated that for major DBB projects, the design fee accounts for ten to twelve percent of the total construction costs. For the DB pilot projects the design fee averages 6.82 percent. Although it is strongly cautioned not to use the DBB design fee percentages as a universal percentage, DB’s lower design fees can be justified. Possible explanations include more efficient design with fewer redesigns since designers are working closely with contractors and since the design is done as the project is being built.

<table>
<thead>
<tr>
<th>DB Project #</th>
<th>DB Bid Price ($)</th>
<th>Design Fee ($)</th>
<th>Design Fee as Percent of Bid Price (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB 1</td>
<td>$11,025,931.51</td>
<td>$869,570</td>
<td>7.98%</td>
</tr>
<tr>
<td>DB 2</td>
<td>$14,178,451.38</td>
<td>$794,249</td>
<td>5.59%</td>
</tr>
<tr>
<td>DB 3</td>
<td>$18,616,040.56</td>
<td>$1,811,974</td>
<td>9.69%</td>
</tr>
<tr>
<td>DB 4</td>
<td>$6,799,019.20</td>
<td>$153,000</td>
<td>2.25%</td>
</tr>
<tr>
<td>DB 5</td>
<td>$3,150,434.75</td>
<td>$424,000</td>
<td>13.25%</td>
</tr>
<tr>
<td>DB 6</td>
<td>$50,283,912.92</td>
<td>$3,476,897</td>
<td>6.91%</td>
</tr>
<tr>
<td>DB 7</td>
<td>$38,671,291.79</td>
<td>$2,668,854</td>
<td>5.85%</td>
</tr>
<tr>
<td>DB 8</td>
<td>$53,167,078.16</td>
<td>$4,773,426</td>
<td>8.97%</td>
</tr>
<tr>
<td>DB 9</td>
<td>$45,623,391.00</td>
<td>$728,577</td>
<td>1.88%</td>
</tr>
<tr>
<td>DB 10</td>
<td>$66,000,000.00</td>
<td>$5,299,280</td>
<td>7.98%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$308,000,000</strong></td>
<td><strong>$20,999,827</strong></td>
<td><strong>6.82%</strong></td>
</tr>
</tbody>
</table>

4.4 Competition/Number of Bidders

Competition among bidders on projects helps to keep the prices in a reasonable range. A low number of bidders was a foreseeable obstacle for the DB pilot projects. The fact that a DBT had to be formed to perform work via the DB delivery presents new territory for many highway contractors and designers in Kentucky. As previously addressed, DB delivery transfers many project risks to the DBT. This alone could be reason enough to discourage potential bidders. To successfully bid and deliver a DB project, it takes full cooperation and coordination among the DBT and between the DBT and the agency. One way to remove some risk from bidders is to
employ a stipend, which partially covers the cost of design for unsuccessful bidders. Since there is a belief that using a stipend incites more competition there is also reason to believe that a stipend could cause bid prices to be lower.

A stipend was used for pilot projects 6 through 10. Analyses were conducted to determine the stipend’s affect on both competition and bid price. Figure 4.3-1 uses the unit cost percent differences that were previously explained. The projects were separated into two groups, stipend and no stipend. Each group shows the average unit cost percent difference among the projects it contains. According to Figure 4.2 there is no evidence linking a stipend to lower bid prices, yet the sample size prevents any statistically reliable findings here.

![Stipend Affect on Cost](image)

**Figure 4.2: Stipend Affect on Cost**
When analyzed for affect on competition, there is some evidence that the use of a stipend has increased competition for the DB pilot projects, although the affect appears to be marginal. Figure 4.3 shows the sum of the number of bidders for each project with a stipend and without a stipend. The 5 projects with a stipend had an average of 2 bidders per project while the 5 projects without a stipend had an average of 1.6. Figure 4.4 shows the mode of the projects with a stipend and without a stipend. The mode for projects with a stipend was bimodal with 1 and 3 bidders being the modes. Projects without a stipend had a mode of 1 bidder.

Regardless of what the data for the projects shows about the affect of a stipend, their use by transportation agencies to reduce the risk to bidders, incite more competition, and keep bid prices competitive is not in question. Perhaps the affect of a stipend for a DB project may be lessened due to the more numerous risks associated with the project itself.

Figure 4.3: Stipend Affect on Competition

Design/Build Qualitative and Quantitative Analysis via Case Study Analyses of Kentucky Transportation Cabinet’s Design/Build Pilot Projects, 73
4.5 Comparison of Design-Build Project with Design-Bid-Build Projects:

The Kentucky Transportation Cabinet (KYTC) has historically used design bid build (DBB) as their primary project delivery method. In 2006, with the approval of the Kentucky General Assembly, The Kentucky Transportation Cabinet chose 9 projects for which to use design-build (DB) delivery. DB delivery offers many attainable advantages including expedited delivery and less administrative burden. In order to determine the success of DB projects it is necessary to compare the performances of DB projects with comparable DBB projects. Therefore a case study template for DBB project was sent to each resident engineer who was responsible for the DB project. The following selection criteria were provided with the case study template to help project that would best suit the comparison study.
Design Bid Build Project Selection Criteria
The following project criteria were used by KYTC personnel/s to select DBB projects for the case study.

1. DBB projects that were completed within last three years
2. DBB projects with scope of work including new alignments, widening, and reconstruction (Note: Bridge and resurfacing projects should not be considered)
3. Project bid amount of more than $10 million
4. Project length of more than one mile
5. Projects that are geographically distributed from all over Kentucky

A total of five case studies were received with basic project information. For the comparison, the cost and schedule performances of the Design-Build versus the comparable Design-Bid-Build projects were calculated (Table 4.3). As shown, the cost growth for DB projects was 0.66% higher than the DBB projects. However, because of expedited schedule requirements DB projects completed 65.42% faster than the DBB projects.

Table 4.4: Comparison of DB and DBB Project Performances

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Design-Build</th>
<th>Design-Bid-Build</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Cost Growth</td>
<td>+4.17%</td>
<td>+3.51%</td>
</tr>
<tr>
<td>Average Schedule Growth</td>
<td>+41.10%</td>
<td>+106.52</td>
</tr>
</tbody>
</table>

In summary, Kentucky’s experience with the before mentioned 9 Design-Build projects mirrored that of other state transportation agencies; there is an added cost of using the Design-Build delivery method, but the projects were completed faster in comparison to similar projects using the Design-Bid-Build delivery method.
5.0 CONCLUSION & RECOMMENDATIONS

Based upon the data analysis and case studies the following conclusions can be drawn.

5.1 Earlier Schedule Certainty

Earlier schedule certainty has been seen on the DB pilot projects due to the nature of the DB process. A construction schedule was required with submission of a bid. Consequently, most of the DBTs had to create a schedule based on limited design. The downfalls of these schedules were their accuracies. Creating an accurate schedule for a DB project is challenging on many levels. It is based on a small amount of design, there are unknowns associated with geotechnical work, permitting, utility relocation, and right of way acquisition. Accordingly, among the 6 pilot projects that have been completed as of June 1, 2011, two projects had no schedule growth, however, the other four projects displayed an average of sixty five percent schedule growth.

5.3 Earlier Cost Certainty

Similar to the argument made against early schedule certainty, early cost certainty is based upon a small amount of design and involves a large amount of risk. The bid submission required a lump sum bid amount to be given. Based on the Cabinet’s 9 pilot Design-Build projects, the average cost growth is 4.17 percent, which indicates that the cost certainty was more accurate than schedule certainty. One reason may be that the DBT has better control of project cost than project schedule. There are numerous factors that can affect the schedule that are mostly out of the DBT’s control. But when it comes to project cost, the DBT can control costs more readily using efficient construction methods and other innovative cost-cutting measures.
5.4 Cost Growth

Change orders did occur on the 9 pilot projects resulting in increased project costs. Furthermore the case study analyses suggest that the DB projects experienced a larger impact due to change orders in comparison to similar DBB projects. The trend of DB projects experiencing larger change orders compared to DBB is mirrored in national studies on the DB delivery method in other state transportation agencies (FHWA 2006). In addition, the fact that the state’s DB projects experienced a 4.17% cost increase is comparable to a Florida DOT study which found that their DB projects averaged a 4.45% cost increase (Ellis et al 2007). Based on this triangulation of results, this study concludes that the cost growth among the state’s DB projects fall within an expected range.

5.5 Overall Quality

There has been no notable difference in quality between the DB pilot projects and any other KYTC projects. There are numerous standards in place as well as QA/QC inspections involved on both DB and DBB projects. One should expect the quality of KYTC DB projects should remain as high as KYTC DBB projects.

5.6 Quality in Procurement

KYTC used a mixer of low bid and best value when selecting the DBT. Normally, DBB projects are chosen solely on low bid. When selecting based on low bid alone there is no way to insure the contractor chosen has a proven track record or can perform the work sufficiently. By requiring the DBTs to justify their credentials, KYTC had a more effective way to choose the most qualified DBT. There is no way to determine whether KYTC’s approach to DBT selection chose the team that would have executed the project in the best, most efficient way. However, one can assume that their selection approach yielded better results than low bid selection alone. The key element of DBT selection, nonetheless, is to maintain clear and objective selection criteria, which will eliminate any subjective bias in the evaluation process.
5.7 Better Constructability

It is the opinion of many project managers and DBT representatives that there has been better constructability associated with the DB pilot projects. Since the designers work more closely with the contractors, the designs are more likely to include contractor suggestions. Specific examples include pre-cast concrete culverts used on DB 8, more efficient cut and fill on several projects, and more efficient construction phase ordering based upon ROW acquisition and utility relocation.

5.8 Less Impact on the Traveling Public

This advantage can be directly related to both project duration and contractor expertise playing a role in MOT. Project durations have been shorter compared to DBB during the DB pilot projects which translates into less impact on the traveling public. There were instances when better maintenance of traffic was noted due to contractor expertise. However, MOT, for the most part, seemed to be dictated by KYTC allowances for lane closures and their times. In summation of this factor, it can be deduced that DB projects do impact the traveling public to a lesser degree than DBB projects.

5.9 Permitting

Permitting can cause massive delays for projects overflowing with environmental concerns. Breaking the project into buildable units helps to mitigate permitting issues, but only to an extent. By KYTC deciding to begin the permitting process before the projects were let, it helped to expedite the project and was appreciated by the DBTs. This practice should continue on future DB projects. When permitting issues were encountered, the general opinion was that they would not have been avoided through DBB delivery. However, when permitting was done expeditiously it could be attributed to DB delivery, the DBT, and the nature and location of the project. One suggestion made was the construction schedule should be let after all necessary
permits are acquired. That could remove risk from the DBT and subsequently could lower the project cost.

5.10 Right of Way

Right of way acquisition has differed among the projects. Some projects required almost no right of way acquisition while others required millions of dollars worth of parcels. Clearly, projects that require more right of way acquisition are exposed to more risk of associated delays. While projects that require little or no right of way have less risk of delay. No matter how much ROW was required, it was clear that having the DBT provide ROW acquisition services was an advantage. It allowed the ROW to be acquired in sequence with the construction schedule. In the case that the acquisition was held up, the contractor knew the severity of the situation immediately and was able to adjust the work accordingly. The DBT handling ROW acquisition has been a definite advantage for the DB pilot projects.

5.11 Utility Relocation

The most common and detrimental cause of problems and delays among the DB pilot projects has been utility relocations. Unfortunately, many of the DBT experienced very similar problems with the timely relocation of existing utilities than what typically occurs on DBB projects. The utility companies have the right to either relocate their own facilities, let the relocation work to public bid, or give permission to the DBT to do the work themselves. Often times the utility company works solely with one pre-chosen contractor that performs all of their utility work in a certain area.

The most successful experiences of utility relocations among the DB pilot projects have occurred when the utility company either worked well with the contractor, adhering to the construction schedule, or allowed the contractor to perform the relocation work themselves. On future DB projects, it is recommended the utility relocations be included in the DB contractor whenever possible, thereby giving the DBT the greatest control over the risk involved with utility relocation.
5.12 Recommendations

Based on the culmination of the case study results and examination of what other states have learned when using the DB delivery method, the following recommendations are made.

1. DB project delivery has its place in the construction industry and for KYTC. The projects best suited for DB delivery should have a strong need for expedited delivery since DB projects are typically completed faster but at a premium for increase in cost in the project’s delivery.

2. KYTC should continue to ensure that the criteria used to select a DBT are transparent, objective, and readily understood by the KYTC personnel involved in the selection process.

3. The scorecard that has been developed as part of this study can be a good tool for the KYTC to predict the success of a project if awarded using DB project delivery method.

4. While DB projects that required minimal utility relocation, permitting, and ROW acquisition typically did better, the case studies did find that DBT were effective when these issues were placed directly under their control by allowing them to better coordinate construction activities and resources required to address these concerns.

5. When utility relocation is required, the relocation work should be included in the DB contract whenever possible to allow the DBT to have direct control over the utility relocation activities.

6. While DBT were found to be effective in handling permitting and ROW issues, the Cabinet should continue assisting the DBT in permitting and ROW acquisition as much as possible.
6.0 REFERENCES


