0-4661-P5

Plan for Performance Benchmarking of SH 130

Authors:
James T. O'Connor
G. Edward Gibson, Jr.
Pramen P. Shrestha
Giovanni C. Migliaccio

Project 0-4661: Monitoring and Evaluation of SH 130 Project Construction

REVISED MARCH 2006

Performing Organization: Center for Transportation Research The University of Texas at Austin 3208 Red River, Suite 200 Austin, Texas 78705-2650		**Sponsoring Organization:** Texas Department of Transportation Research and Technology Implementation Office P.O. Box 5080 Austin, Texas 78763-5080
Performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration.		
Abstract: This research report contains the plan for the SH 130 performance benchmarking program. It lays out the benchmarking methodology and identifies input and output parameters to be included in the benchmarking of SH 130.	**Keywords:** Benchmarking, Comprehensive Development Agreement, Design-Build, Design-Bid-Build.	**No. of Pages:** 80

Table of Contents

List of Figures

List of Tables

1. Introduction

1.1 SH 130 Project Overview and Delivery Method

Interstate Highway 35 (IH-35) is the only major north-south transportation corridor through Central Texas, and the recent rapid urbanization of this area, especially around Austin, has increased traffic congestion. To relieve this traffic congestion, the Texas Department of Transportation (TxDOT) has started constructing a commuter and NAFTA corridor alternative to IH-35 with a system of new toll roads called the Central Texas Turnpike Project (CTTP).

The first phase of the three-part CTTP includes the following:

- State Highway 130 (SH 130): Georgetown to US 183 South (approximately 49 miles)
- State Highway 45 North (SH 45 N): RM 620 to SH 130 (approximately 13 miles)
- Loop 1: FM 734 (Parmer Lane) to SH 45 North (approximately 3.5 miles)

As an element of the CTTP, SH 130 is the state's first highway to be developed under a Comprehensive Development Agreement (CDA). This CDA is an innovative design-build (DB) project delivery method that allows the Developer to simultaneously undertake right-of-way (ROW) acquisition, utility adjustment, design, and construction.

The length of SH 130 is 49 miles, extending from IH-35 north of Georgetown southward to US 183 southeast of Austin, and passing through Williamson and Travis Counties. SH 130 will be a four-lane toll road with major interchanges at IH-35, US 79, SH 45 N, US 290, SH 71 and US 183. Construction of SH 130 started in the fall of 2003 and is expected to be completed by December 2007. The total estimated cost of this project is $1.5 billion, including $300 million for ROW acquisition.

Under the terms of this CDA, TxDOT has an optional maintenance agreement for the SH 130 with the Developer. The organizational structure of this project is significantly different from traditional design-bid-build (DBB) projects. In this CDA, TxDOT hired a Program Manager (PM), HDR Engineering, Inc., as an extension of its staff. The Developer, Lone Star Infrastructure (LSI), is responsible for designing and building the SH 130 highway project. LSI, then, works under the supervision of TxDOT and the PM. Figures 1.1 and 1.2 show the organizational structure of traditional DBB and DB project delivery methods (Design Build Institute of America, 2005).

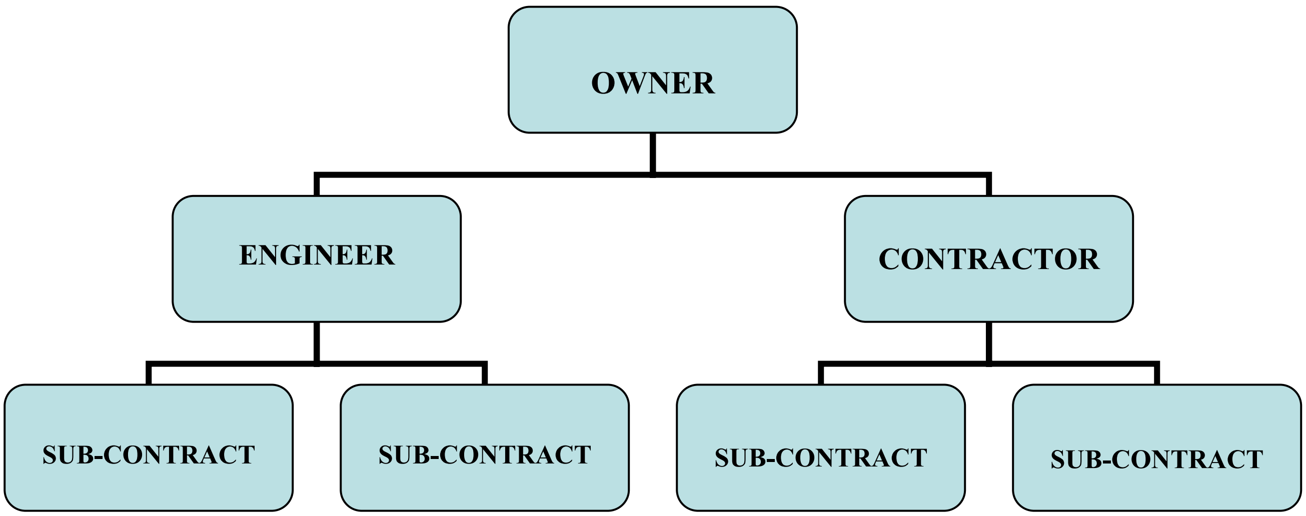

Figure 1.1 Typical Organizational Structure of Design-Bid-Build Project

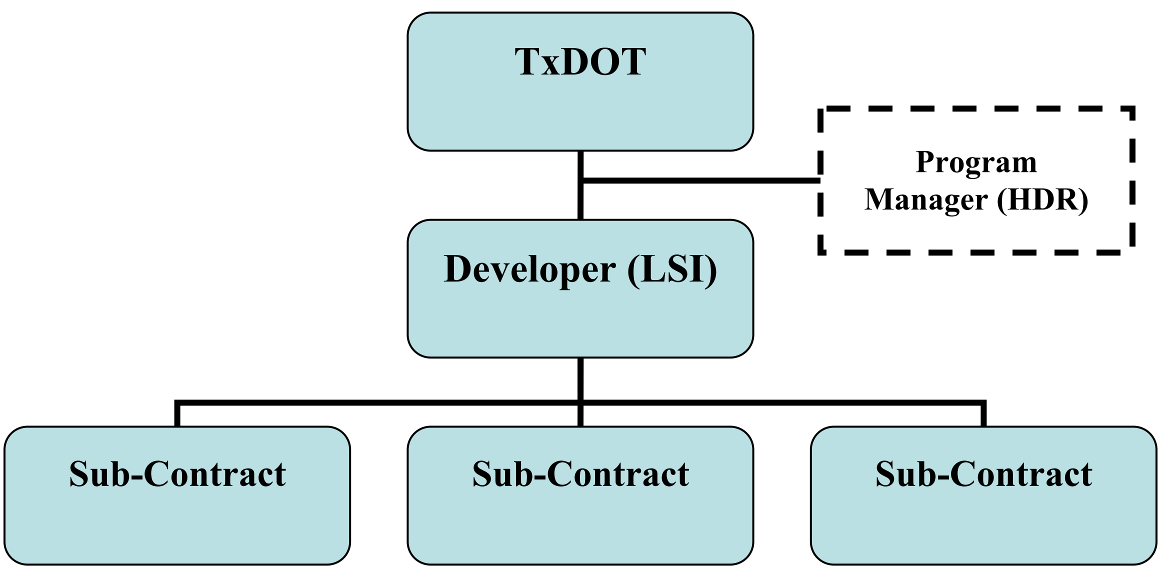

Figure 1.2 Typical Organizational Structure of Design-Build SH 130 Project

Highway projects have different phases, including feasibility study, planning, road schematic, detail design, construction, operation, and periodic maintenance phases (Koppinen and Lahdernpera, 2004). The procurement system of each project phase is different in traditional DBB and DB models. In a DBB project, the owner contracts design and construction services with two different contractors. However, in a DB project, the owner gives the responsibility of design and construction to one contractor. Benchmarking Motives and Objectives

Because of the need to expedite completion, SH 130 is being built under the first CDA for a state highway project in Texas. As stated, a CDA is significantly different from the traditional DBB process in which project planning, design, ROW acquisition, and construction are treated as separate sequential phases. However, under this CDA, construction can begin while design, ROW acquisition, and utility adjustment continue on un-built parts of the road alignment.

Benchmarking is the process by which the performance of a particular project is compared to other industry projects to determine what processes work best. The American Productivity and Quality Centers (APQC) defined benchmarking as "the process of identifying, sharing, and using best practices to improve business processes" (Benchmarking and Best Practices, APQC, 2005).

Because the CDA method is being used for the first time on a state highway project in Texas, it is desirable to track the performance of this project to assess whether this project delivery method is the best alternative for building high priority highways. Therefore, it is necessary to benchmark the SH 130 project against other similar highway projects. Thus the main motives of benchmarking the SH 130 project are:

- To determine whether the CDA process has yielded anticipated results in the construction of the SH 130 project
- To assess whether the CDA process is more beneficial than traditional DBB methods in constructing highway projects in the state of Texas

- To find out from the context of SH 130 whether the CDA process should be used widely in the state of Texas for building high-priority highway projects
- To determine what improvements can be made in the CDA process to make such highway projects more successful in terms of cost, schedule, and quality

The main objectives of benchmarking the SH 130 project are to:

- Quantify the benefits and disadvantages of the CDA process in the context of SH 130
- Determine the performance of the SH 130 CDA project in terms of cost, schedule, safety, quality, change orders, and claims
- Compare the performance of the SH 130 project against similar ongoing in-state DBB highway projects
- Compare the performance of SH 130 project against similar recently built, out-of-state DB highway projects
- Compare the performance of the SH 130 project against similar ongoing in-state DB highway projects

1.2 Benchmarking Limitations

Performance benchmarking of construction projects is difficult and complex, because all the projects and contractors building the projects are different. Therefore there are certain limitations of this benchmarking, they are:

- Performance benchmarking of SH 130 against DB projects reflects the performance of only some FHWA SEP 14 highway projects.
- SH 130 is not benchmarked against Build-Operate-Transfer (BOT) / Concession projects.
- Benchmarking of SH 130 does not include international projects.
- Limited number of in-state DBB and out-of-state DB projects were selected for benchmarking purpose.

1.3 Scope Limitations

This product contains the plan for the SH 130 performance benchmarking program. It lays out the benchmarking methodology and identifies input and output parameters to be included in the benchmarking of SH 130. While data collection for the benchmarking program is in progress, the report does present data collected from the project websites and from telephone inquiries made to project staff.

Included in the scope of this product is an overview of the benchmarking methodology and of the input and output parameters. Comprehensive discussions of data collection, analysis, and findings will be presented in the final technical report.

1.4 Structure of the Report

Subsequent to this chapter, the report is structured as follows:

- **Chapter 2** presents the literature review done to develop benchmarking methodology of the SH 130.
- **Chapter 3** lays out the benchmarking methodology of this research work.
- **Chapter 4** describes the development of input and output parameters for the benchmarking of SH 130.
- **Chapter 5** outlines the identification and selection processes of out-of-state and in-state highway projects.
- **Chapter 6** presents preliminary data collected from various sources, such as websites, newsletters, and telephone conversations and the plan of data collection and analysis for benchmarking the SH 130 project.
- **Chapter 7** draws preliminary conclusions for the performance benchmarking methodology.

2. Literature Review

2.1 Source Citations

A literature review was conducted to determine various benchmarking methodologies used in different industries. The relevant literature and source information analyzed include the following:

- American Product and Quality Circle (APQC) Web site
- Texts related to benchmarking
- Construction Industry Institute (CII) Web site and related benchmarking and metrics research reports
- Finnish Road Administration Web site
- *Journal of Construction Engineering and Management,* American Society of Civil Engineers
- National Cooperative Highway Research Program publications
- Online Ph. D. dissertation database, The University of Texas at Austin
- Research reports produced by the Center for Transportation Research, The University of Texas at Austin
- Technical Research Center of Finland (VTT) Web site
- Transportation Research Board (TRB) Web site
- Other Internet searches

2.2 CII Benchmarking Process

The Construction Industry Institute (CII) is a leading organization in the benchmarking of capital facility projects (CII, Benchmarking and Metrics, 2005). Its Benchmarking and Metrics Program was established to fulfill two goals:

- Providing quantitative information to member companies on the benefits of using CII-endorsed best practices on overall project performance

- Assisting member companies in statistical measurements that can improve capital project effectiveness

The CII Benchmarking and Metrics Program has developed project performance and practices-use metrics with which to compare construction industry projects. The performance metrics are related to project cost, schedule, change, rework, safety, and productivity performances. The practice-use metrics are related to preplanning, organization, change management, constructability, and zero accidents.

Because some of the performance metrics for owners are different from those for contractors, CII has developed two sets of different questionnaires to allow owners and contractors to collect and submit data. The submission of the data is on a voluntary basis. The CII questionnaires are divided into the following sections (CII, 2004):

- Project General Information
- Project Performance
- Practices Used
- Construction Productivity Metrics
- Engineering Productivity Metrics
- Closeout

CII benchmarks its member companies' projects without sharing their voluntarily-submitted data with any other organizations (CII, 2004). Each year, CII produces findings from submitted data for its member companies. It has produced several reports regarding benchmarking and metrics, most of which concentrate on the performance of the projects compared to industry best practices used (CII, 2003).

Recently, research was done by CII to measure the impacts of the DB and DBB delivery systems on project performance. Analysis was based on data submitted voluntarily by CII member companies to its Benchmarking and Metrics Program. Some of the findings of this research are (CII and NIST, 2002):

- On average, DB projects were about four times larger than DBB projects in terms of project cost.

- Public sector projects made less use of the DB project delivery system than private sector projects.
- Overall, owner-submitted DB projects outperformed DBB projects in cost, schedule, changes, rework, and practice use. However, statistically significant differences were found only for schedule, changes, rework, and practice use.
- Contractor-submitted DB projects outperformed DBB projects in changes, rework, and practice uses, but the difference was statistically significant only for change performance.
- Contractor-submitted DBB projects outperformed DB projects in schedule, and the difference was statistically significant.

The report explained the reasons of contractor-submitted DBB outperforming DB projects in schedule as follows: "It is worth reviewing how contractor DB and DBB projects were defined. Projects were defined as DB when the contractor performed the majority of the design and construction functions. They were defined as DBB if the contractor performed the design function only, the construction function only, or either the majority of the design (construction) function and less than 50% of the other function. Since three of the four schedule metrics require the use of predicted durations, DBB contractors may have been better able to predict duration either because of the function they performed or the point in time at which they began the project. In the case of design only contractors, predicting duration may have been made easier because many of the factors that lead to schedule growth, such as unforeseen site conditions or unexpected delays in the procurement and delivery of materials, were not part of their scopes of work. In the case of construction only contractors, prediction may have been facilitated by the fact that they were able to make predictions later in the life cycle of a project about only one of the major functions."

2.3 Other Benchmarking Processes

Benchmarking started in the early 1980s when Xerox developed a program to establish the performance goals for all of their performed tasks in order to have better quality products (Camp, 1989). They called this the "benchmarking" of their company. Today, it is necessary for all companies to benchmark their performance in order to know how well they are performing compared to other companies. Benchmarking is the process that compares one's performance to the industry's best performance. Every business, whether it deals with construction, production, or customer service, requires some process of self-evaluation because this process can determine process deficiencies in a company, the first step in advancing performance.

In 1993, with the introduction of the Government Performance and Results Act (GPRA), the United States government required all agencies to quantify performance of all federal programs (Brunso and Siddiqi, 2003). In compliance with this requirement, the U.S. Army Corps of Engineers (Corps) has already started benchmarking its administrative performance of federal programs.

The Corps performed a study to evaluate project delivery of environmental restoration programs by using benchmarks and metrics. This research study evaluated the ability of one of these federally-funded environmental restoration programs to deliver projects: the Environmental Management Program (EMP). To benchmark this project, researchers selected some common performance metrics (e.g., cost growth, schedule growth, planning, and design phase cost factors, etc.) developed by CII. The researchers also subjectively evaluated whether the design goals had been met. They also addressed the customer's concern over operation and maintenance (O & M) costs by calculating actual O & M cost divided by estimated O & M cost. From these metrics they found that the Corps had made improvement in delivering EMP projects because the cost and schedule growth of these projects were found to be under control.

Research was done in 1998 by Mark Konchar and Victor Sanvido regarding the benchmarking of federal project delivery systems. The researchers benchmarked construction management-at-risk, DB, and DBB project delivery methods. They compared the cost, schedule, and quality metrics of 351 building projects being built under these three project delivery methods. From their research, they concluded that DB project delivery can achieve significantly improved cost and schedule advantages. It also can produce equal and sometimes more desirable quality performance than construction management-at-risk and DBB projects (Konchar and Sanvido, 1998).

In 2003, Booz Allen Hamilton carried out research for the National Cooperative Highway Research Program to develop a primer and a guide on customer-driven benchmarking of maintenance activities (of highway projects). Because maintenance of a highway is often related to the road user's satisfaction, the researchers developed customer-oriented maintenance performance metrics. The findings of this study suggest that it is necessary for maintenance organizations to focus more on customer-oriented measures such as smoothness of roads, legibility of signs at night, sight distance at intersections, attractiveness of roadsides, and the speed at which ice and snow melts on pavement (Hamilton, 2003). The researcher used the following "outputs" for measures of accomplishments: linear feet of ditches cleaned, number of bags of litter collected, and acres of grass mowed. He used as "inputs" resources used in maintenance activities such as labor, material, equipment, and financial cost. The steps of this benchmarking process as described by the researcher are as follows:

1. Select partners
2. Establish customer-oriented measures
3. Measure performance
4. Identify best performances and practices
5. Implement best practices and continuously improve performances

There is a considerable body of literature regarding benchmarking. From a wide variety of literature found on benchmarking, one report summarized the benchmarking process as follows (Hamilton, 2003):

1. Involve and get support of top management
2. Establish what to benchmark
3. Determine what and how to measure
4. Identify comparable external and internal organizations and processes
5. Prepare a data collection plan
6. Collect data

7. Use quantitative measures to identify best performance
8. Compare one's own performance with the industry best performance
9. Identify the root causes of any performance gap
10. Prepare an action plan for improvement
11. Get support from top management level to implement the action plan
12. Implement the action plan
13. Monitor the plan

In his Ph.D. dissertation completed at The University of Texas at Austin, David R. Shield (2002) developed an index for scoring the success of the construction phase of projects with the help of CII benchmarking data. Owners and contractors can benchmark their construction performance with the help of this index. This study concluded that the index may be used to internally and externally benchmark the company's construction phase success on their industrial construction projects (Shield, 2002).

In 1990, Sanvido et al. identified critical success factors (CSFs) for construction on building projects. Researchers analyzed qualitative data from sixteen building projects to develop numerical scores. This research identified seven CSFs that must be given special and continual attention to bring about high project construction performance (Sanvido et al., 1992). These critical success factors are: facility team, contracts, experience, optimization information, resources, product information, and performance information.

In 1990, CII and the U.S. Navy sponsored a demonstration research study that focused on project performance and benchmarking for a Navy maintenance facility being built in Portsmouth, Virginia (O'Connor et al., 1995). The researchers quantified the project performance impact from the Navy's implementation of six CII best practices: project objective setting, project scope definition, design effectiveness, constructability, and materials management.

Recently, Thomas R. Warne of Tom Warne & Associates, LLC. prepared a report regarding performance assessment of DB contracting for highway projects (Warne, 2005).

The author studied twenty-one DB highway projects across the country ranging in size from $83 million to $1.3 billion. The main goal of this research was to ascertain the performance characteristics of DB highway projects. These performance characteristics will allow owner to assess the effectiveness of the DB project delivery process.

The researcher gathered a significant amount of information about each of the twenty-one DB highway projects and analyzed it. The analysis was summarized in two sections, Design-Build Performance and Design-Build Process. The main findings in the DB performance section are (Warne, 2005):

- Seventy-six percent of the DB projects were finished ahead of schedule.
- One hundred percent of these selected projects were built faster with the DB approach than they would have been with the DBB approach.
- DB offers greater price certainty and reduced cost growth than DBB.
- One hundred percent of the owners were happy with DB approach and would use it again.

The main findings in the design-build process are:

- Because the roles and responsibilities in the DB process differ from the DBB process, it is necessary that all parties (e.g., owners, designers, and contractors) adjust their processes and organizations accordingly
- Owners often choose to use the DB process if the project has to meet specific schedule constraints like those involved in building toll roads.
- Thirty-eight percent of the owners who participated in this study paid a stipend to compensate unsuccessful proposers for the costs of preparing their proposals.
- The emerging approach for selecting the design-builder is the “best value” process. This is an approach by which the successful proposer is selected based on price and other factors such as management and schedule.

3. Benchmarking Methodology Overview

3.1 Benchmarking Model

The SH 130 project is an innovative demonstration project from which TxDOT can learn many implementation lessons. The performance (i.e., output) of any project depends upon the type and amount of inputs applied on that project. Therefore, during the benchmarking of SH 130, the inputs and outputs of selected highway projects will be compared with those of the SH 130 project. For this purpose, both out-of-state and in-state projects will be analyzed. For the out-of-state comparisons, only DB projects will be screened. For the in-state comparisons, both DB and DBB projects will be screened. The model for benchmarking SH 130 is depicted in Figure 3.1.

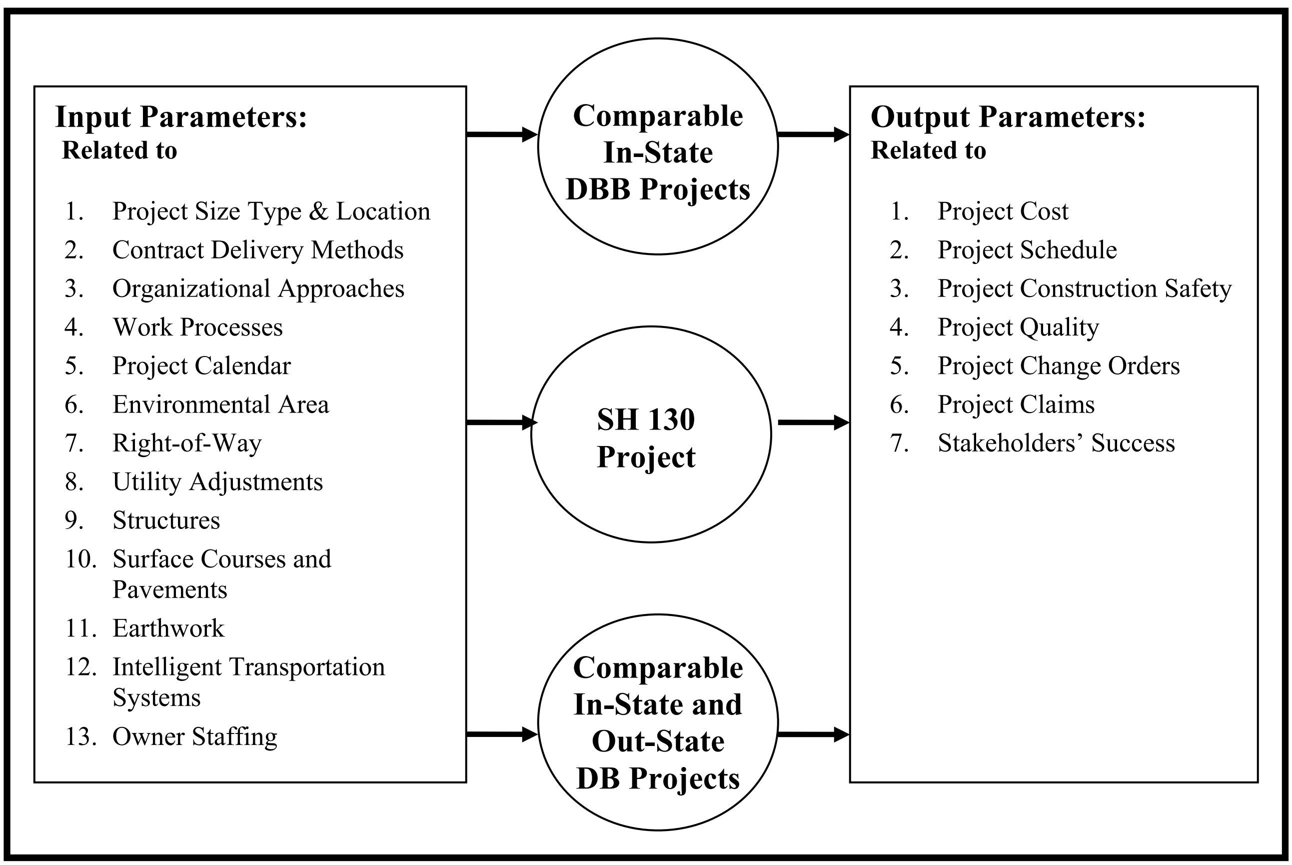

Figure 3.1 Model for Benchmarking SH 130

3.2 SH 130 Benchmarking Methodology

The research methodology for benchmarking SH 130 is depicted in Figure 3.2 and can be described as follows:

1. Conduct literature review and find research documents regarding benchmarking of highway projects
2. Develop input parameters which can affect output (performance) parameters of the highway projects
3. Identify and develop output (performance) parameters which can be used to compare the SH 130 project to similar highway projects
4. Identify in-state DBB highway projects that can be compared to the SH 130 project for benchmarking purposes
5. Identify in-state DB highway projects that can be compared to the SH 130 project for benchmarking purposes
6. Identify the project characteristics of out-of-state DB projects that can be compared to the SH 130 project
7. Select the most comparable out-of-state DB highway projects for benchmarking of the SH 130 project
8. Collect preliminary data
9. Finalize the input and output parameters
10. Develop a detailed data collection plan
11. Collect data for the SH 130 project and other similar DBB and DB highway projects
12. Conduct comparative analysis
13. Develop conclusions and recommendations
14. Add lessons learned to the database system of Research Task 6

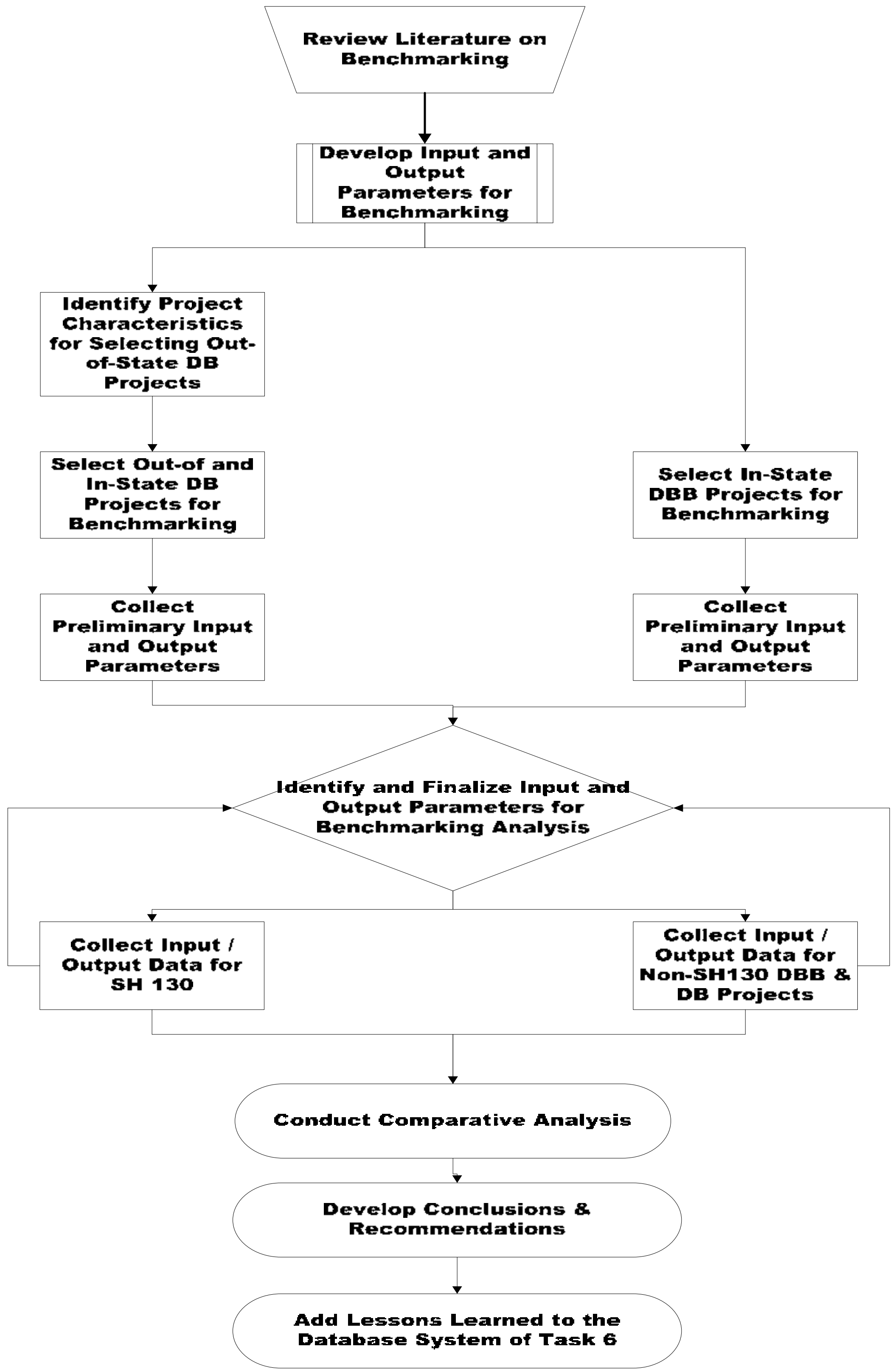

Figure 3.2 Benchmarking SH 130 Research Methodology

4. Input and Output Parameters

4.1 Input Parameters

The input parameters for benchmarking are divided into subcategories according to the highway construction work areas. These parameters have been selected by considering their impact on the project performance metrics. These input parameters were updated and reviewed during the Project Monitoring Committee (PMC) meeting March 3, 2005. They will be adjusted according to the availability of data during the data collection phase. The input parameters identified thus far are shown in Tables 4.1 to 4.13.

Table 4.1 Project Size, Type, and Location-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Project Bid Cost	$ MM	Quantitative	Yes	Owner	During Project
2. Project Bid Duration	Days	Quantitative	Yes	Owner	During Project
3. Location Type (Urban / Rural)	-	Qualitative	Yes	Owner	During Project
4. Construction Type (New / Rehab. / Recons. / Expan.)	-	Qualitative	Yes	Owner	During Project
5. Construction under Traffic (Y / N)	-	Qualitative	Yes	Owner	During Project
6. Toll Road (Y / N)	-	Qualitative	Yes	Owner	During Project

<u>Definition of Terms:</u>

Project Bid Cost: The amount bid by the contractor during contract bidding time.
Project Bid Duration: The duration bid by the contractor to complete the project.
Urban: A project located inside a metropolitan area.
Rural: A project located outside a metropolitan area.
New Highway Construction: Work done on a highway that is built as a grass root project.
Highway Rehabilitation: Work done to improve existing highway's pavements or bridge structures.
Highway Reconstruction: The dismantlement and reconstruction of an existing highway.
Highway Expansion: The addition of lanes, or addition of levels of interchange, or extension of exiting highway.
Toll Road: A highway that is funded by the toll collected from its users.

Table 4.2 Contract Delivery Method-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Contractor Selection Method	-	Qualitative	Yes	Owner	During Project
2. Type of Contract	-	Qualitative	Yes	Owner	During Project
3. % of Conceptual Design	%	Quantitative	Yes	Owner	During Project
4. ROW Acquired Before Contract (Y / N)	-	Qualitative	Yes	Owner	During Project
5. Utility Adjustment Before Contract (Y / N)	-	Qualitative	Yes	Owner	During Project
6. Liquidated Damage Amount	$ / day	Quantitative	Yes	Owner	During Project
7. One-Time Bonus	$	Quantitative	Yes	Owner	During Project
8. Incentive of Early Substantial Completion	$ / day	Quantitative	Yes	Owner	During Project
9. Disincentive for Late Completion	$ / day	Quantitative	Yes	Owner	During Project
10. Lane Rental	$ / Hr / L	Quantitative	Yes	Owner	During Project
11. Operation and Maintenance Included (Y / N)	-	Qualitative	Yes	Owner	During Project
12.Type of Specification (Performance / Prescriptive)	-	Qualitative	Yes	Owner	During Project

<u>Definition of Terms:</u>

Contractor Selection Method: The process by which the contractor is selected for a project (e.g., best value, low bid, or A+B bidding, etc.).
Type of Contract: The type of contract governing a project (e.g., DBB, DB, CDA, or CM at risk, etc.).
Liquidated Damage: An amount agreed on in advance between contractual parties as a reasonable reparation for damages incurred to one in the event of a breach of the contract by the other.
One-Time Bonus: An amount stipulated in the contract the owner will pay if the project is completed in the scheduled time.
Incentive for Early Substantial Completion: An amount per day the owner will pay to the contractor if the project is completed ahead of the scheduled end date.
Disincentive for Late Completion: An amount per day the contractor will pay to the owner if the project is not completed by the scheduled end date.
Lane Rental: An amount per hour per lane that the contractor will pay if the lane is closed during the construction of a highway project.

Table 4.3 Organizational Approach-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Formalized Partnering	-	Qualitative	Yes	Owner	During Project
2. Alignment	-	Qualitative	Yes	Owner	During Project
3. Pre-Project Planning	-	Qualitative	Yes	Owner	During Project
4. Involvement of GEC	-	Qualitative	Yes	Owner	During Project
5. No. of Subcontracts	No.	Quantitative	Yes	Contractor	During Project
6. Co-Location	-	Qualitative	Yes	Owner	During Project
7. Private CM's Involvement	-	Qualitative	Yes	Owner	During Project
8. Change Management	-	Quantitative	Yes	Owner	During Project
9. Communication	-	Qualitative	Yes	Owner	During Project
10. Value Engineering	-	Qualitative	Yes / No	Owner	During Project
11. Constructability	-	Qualitative	Yes / No	Owner	During Project

Definition of Terms:

Partnering: A commitment between owner and contractors to improve communication and avoid disputes.

Alignment: The working process of the appropriate project participants toward developing and meeting a uniformly defined and understood set of project objectives (CII, 2005).

Pre-Project Planning: The process of developing sufficient strategic information for owners to assess risk and commit resources to maximize the chances for a successful project (CII, 2005).

Co-Location: A project environment wherein all the project parties, (e.g., owner, contractor, and designer) are located in the same building.

Change Management: The process of incorporating a balance changed culture, one that involves recognition, planning, and evaluation of project changes in an organization to effectively manage project changes (CII, 2005).

Value Engineering: Any engineering practice that enhances cost, time, safety, quality, etc. of a project and aids project teams in meeting client's expectations, goals, and project objectives (CII, 2005).

Constructability: The effective and timely integration of construction knowledge into the conceptual planning, design, construction, and field operations of a project to achieve the overall project objectives with the best possible time and accuracy at the most cost effective levels (CII, 2005).

Table 4.4 Work Process-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Use of Latest Technology	-	Qualitative	Yes	Owner	During Project
2. Use of Information Technology	-	Qualitative	Yes	Owner	During Project
3. Project Web Portal	-	Qualitative	Yes	Owner	During Project

Definition of Terms:

Use of Latest Technology: Use of any type of technology on the construction site to improve the quality and reduce project cost and duration.

Use of Information Technology: Use of any IT software to improve the work processes of the project.

Project Web Portal: The Internet web site of the project used to inform people and report the progress of the project.

Table 4.5 Project Calendar-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Work Week (4-5-6-7 days)	Days	Quantitative	Yes	Contractor	During Project
2. Work Shift (Single / Multiple)	No.	Quantitative	Yes	Contractor	During Project
3. Winter Severity	Days	Quantitative	Yes	Owner	During Project
4. Major Delay	Days	Quantitative	Yes	Owner	During Project

Definition of Terms:

Work Week: The number of days that design or construction staff work per week on the project.

Work Shift: The number of shifts that design or construction staff work on the project.

Winter Severity: The number of days the construction work is delayed due to severe snowfall.

Major Delay: The number of days the construction work is delayed due to unforeseen reasons.

Table 4.6 Environment-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Environmental Delays	No.	Quantitative	Yes	Owner	During Project
2. SW3P Issues	No.	Quantitative	Yes	Owner	During Project
3. Change of Alignment	-	Qualitative	Yes	Owner	During Project
4. Wetlands Affected	Acres	Quantitative	Yes	Owner	During Project
5. Water Crossings	No.	Quantitative	Yes	Owner	During Project
6. Remediation	No.	Quantitative	Yes	Owner	During Project
7. Endangered Species	No.	Quantitative	Yes	Owner	During Project
8. Historical Properties	No. or SF	Quantitative	Yes	Owner	During Project
9. WPAP for Recharge Zones	No.	Quantitative	Yes	Owner	During Project
10. Archeo-Paleo	No.	Quantitative	Yes	Owner	During Project

Definition of Terms:

SW3P (Storm Water Pollution and Prevention Plan): A plan required by the Federal Water Pollution Control Act to maximize the potential benefits from pollution prevention and sediment and erosion control measures at construction sites (United States Environmental Protection Agency, 2005).

Wetlands: Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (USEPA, 2005).

Remediation: An environment pollution control measure taken to mitigate the environmental impact due to construction of highway.

Endangered Species: Endangered species are plants and animals that are so rare they are in danger of becoming extinct. Species become endangered because of changes to the earth that are caused either by nature or by human activity. Under the Endangered Species Act of 1973, Congress provided for the conservation of endangered species and their habitats (USEPA, 2005).

WPAP for Recharge Zone: In some states, a water pollution abatement plan (WPAP) is required for any regulated activity proposed on the aquifer recharge zone. This includes any construction-related activity on the recharge zone.

Archeo - Paleo Site: Refers to an archeological and paleontological site; archeology is related to human remains, and paleontology is related to study of fossils of living beings.

Table 4.7 Right of Way-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Total ROW Parcels	No.	Quantitative	Yes	Owner	During Project
2. Procurement Responsibility	-	Qualitative	Yes	Owner	During Project
3. % of Condemnation	%	Quantitative	Yes	Owner	During Project
4. % of Administrative Settlement After or Before Project Start	%	Quantitative	Yes	Owner	During Project
5. ROW Budget	$	Quantitative	Yes	Owner	During Project

Definition of Terms:

ROW Parcels: Pieces of land to be acquired from private landowners for the construction of a highway project.

Condemnation: The process of taking private property for public use through the power of eminent domain. When private property is taken by the government, the owner is entitled to receive just compensation.

Administrative Settlement: The negotiating process setup within state highway authorities to acquire ROW parcels.

Table 4.8 Utility Adjustment-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Utility Adjustments	No.	Quantitative	Yes	Owner	During Project
2. Length of Utility Adjustments	LF	Quantitative	Yes	Owner	During Project
2. SUE Budget	$	Quantitative	Yes	Owner	During Project
3. Utility Adjustment Budget	$	Quantitative	Yes	Owner	During Project
4. Utility Adjustment Before or After Contract	-	Qualitative	Yes	Owner	During Project

Definition of Term:

Subsurface Utility Engineering (SUE): The engineering approach that involves managing certain risks associated with utility mapping, utility coordination, utility relocation design and coordination, condition assessment, communication of utility data to concerned parties, relocation cost estimates, implementation of accommodation policies, and utility design.

Table 4.9 Structure-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Total No. of Interchanges	No.	Quantitative	Yes	Owner	End of Project
2. Level of Interchange	No.	Quantitative	Yes	Owner	End of Project
3. Total No. of Bridges	No.	Quantitative	Yes	Owner	End of Project
4. Type of Bridge	-	Qualitative	Yes	Owner	End of Project
5. Areas of Bridge Deck	SF	Quantitative	Yes	Owner	End of Project
6. Total Length of Bridge	LF	Quantitative	Yes	Owner	End of Project
7. Average Height of Bridge	LF	Quantitative	Yes	Owner	End of Project
8. Maximum Height of Bridge	LF	Quantitative	Yes	Owner	End of Project
9. Total Length of Box Culvert	LF	Quantitative	Yes	Owner	End of Project
10. Total Length of Pipe Culvert	LF	Quantitative	Yes	Owner	End of Project
11. No. of Frontage Roads	No.	Quantitative	Yes	Owner	End of Project
12. No. of Freeway Ramps	No.	Quantitative	Yes	Owner	End of Project
13. No. of Toll Plazas	No.	Quantitative	Yes	Owner	End of Project

Definition of Terms:

Interchange: A road junction that utilizes grade separation and one or more ramps to permit traffic on at least one road to pass through the junction without crossing any other traffic stream.

Frontage Road: An unlimited access road running parallel to a higher-speed road, usually a freeway, and feeding it at appropriate points of access.

Freeway Ramp: A road in a freeway system designed as an entrance and exit to a highway.

Toll Plaza: A station on a toll road at which toll booths are erected to collect the tolls from users.

Table 4.10 Surface Course and Pavement-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Pavement Type (Asphalt / PCC / RCC)	-	Qualitative	Yes	Owner	End of Project
2. Average Thickness of Pavement	Inches	Quantitative	Yes	Owner	End of Project
3. Total Area of Pavement	SY	Quantitative	Yes	Owner	End of Project
4. Total Length of Highway	Miles	Quantitative	Yes	Owner	End of Project
5. Total Length of Main Lanes	Lane Miles	Quantitative	Yes	Owner	End of Project
6. Total Length of Frontage Road	Lane Miles	Quantitative	Yes	Owner	End of Project
7. Total Length of HOV Lane	Lane Miles	Quantitative	Yes	Owner	End of Project
8. Total Length of Toll Lane	Lane Miles	Quantitative	Yes	Owner	End of Project

Definition of Terms:

Main Lane: A highway lane built for vehicles to travel at a designated speed.

High Occupancy Vehicle (HOV) Lane: A lane built for vehicles carrying one or more passengers.

Toll Lane: A lane of a highway in which a toll booth is erected for collecting tolls.

Table 4.11 Earthwork-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Earthwork Excavation	CY	Quantitative	Yes	Owner	End of Project
2. Embankment Filling	CY	Quantitative	Yes	Owner	End of Project
3. Earthwork Excavation Type (Rock / Dirt)	%	Quantitative	Yes	Owner	End of Project

Definition of Term:

Earthwork Excavation Type: The type of excavated earthwork on a highway project (e.g., hard rock, soft rock, dirt, loose soil, etc.).

Table 4.12 Intelligent Transportation System (ITS)-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Type of ITS Installed	-	Qualitative	Yes	Owner	End of Project
2. Total ITS Budget	$	Quantitative	Yes	Owner	End of Project

<u>Definition of Term:</u>

Intelligent Transportation System (ITS): A transportation initiatives that aims to manage vehicles, loads, and routes to improve safety and reduce vehicle wear, transportation times, and fuel costs.

Table 4.13 Owner Staffing-Related Input Parameters Profile

Name of Parameters	Units	Type	Availability	Source	Timing of Data Collection
1. Total Owners' Full Time Equivalent (FTE)	No.	Quantitative	Yes	Owner	End of Project
2. Type of FTE	-	Qualitative	Yes	Owner	End of Project

<u>Definition of Term:</u>

Full Time Equivalent (FTE): A measure of a worker's productivity and/or involvement in a project.

4.2 Output Parameters

The output parameters are the performance metrics of the projects. These are subdivided according to performance related to cost, schedule, quality, safety, change orders, claims, and stakeholders' success. All performance metrics are quantitative except the stakeholders' success, which is a subjective judgment. Most of the output performance metrics related to cost, schedule, safety, and change order used in benchmarking of the SH 130 were already used in previous benchmarking of construction projects by CII.

The output parameters will be later adjusted according to the data availability during the data collection phase. The detailed profiles of output parameters to be considered in benchmarking of the SH 130 project are illustrated in Tables 4.14 to 4.19.

Table 4.14 Project Cost-Related Output Parameters Profile

Name of Parameters	Units	Attributes Measured	Metric Classification	Formula	Availa-bility	Source
1. Actual Total Project Cost (ATPC)	$	Project Cost	Absolute	None	Yes	Owner
2. Initial Predicted Project Cost (IPPC)	$	Project Cost	Absolute	None	Yes	Owner
3. Actual Total Design Cost (ATDC)	$	Design Cost	Absolute	None	Yes	Owner
4. Initial Predicted Design Cost (IPDC)	$	Design Cost	Absolute	None	Yes	Owner
5. Actual Total Constr. Cost (ATCC)	$	Constr. Cost	Absolute	None	Yes	Owner
6. Initial Predicted Constr. Cost (IPCC)	$	Constr. Cost	Absolute	None	Yes	Owner
7. Total Utility Adjust. Cost (TUAC)	$	Utility Adj. Cost	Absolute	None	Yes	Owner
8. Total Right-of-Way Cost (TROWC)	$	ROW Cost	Absolute	None	Yes	Owner
9. Total Bridge Cost (TBC)	$	Bridge Cost	Absolute	None	Yes	Owner
10. Project Cost Growth	%	Project Cost Predictability	Relative	$\frac{ATPC - IPPC}{IPPC}$	Yes	Calculate
11. Design Cost Growth	%	Design Cost Predictability	Relative	$\frac{ATDC - IPDC}{IPDC}$	Yes	Calculate
12. Design Cost Factor	%	Design Cost Predictability	Relative	$\frac{ATDC}{ATPC}$	Yes	Calculate
13. Construction Cost Growth	%	Constr. Cost Predictability	Relative	$\frac{ATCC-IPCC}{IPCC}$	Yes	Calculate
14. Construction Cost Factor	%	Constr. Cost Predictability	Relative	$\frac{ATCC}{ATPC}$	Yes	Calculate
15. Utility Adjust. Cost Per Linear Feet	$/LF	Utility Cost Predictability	Relative	$\frac{TUAC}{TLU}$	Yes	Calculate
16. Bridge Cost Per Area	$/SFT	Bridge Cost Predictability	Relative	$\frac{TBC}{TAB}$	Yes	Calculate
17. Highway Cost Per Lane Mile	$/LM	Highway Cost Predictability	Relative	$\frac{ATPC}{TLM}$	Yes	Calculate

TLU – Total Length of Utility **TAB –** Total Area of Bridge **TLM –** Total Lane Mile

Definition of Terms:

Actual Total Project Cost (ATPC): The total cost of design and construction excluding cost of right-of-way to construct the highway project (CII, 2005).

Initial Predicted Project Cost (IPPC): The owner's budget at the time of a highway project authorization (CII, 2005).

Actual Total Design Cost (ATDC): The actual cost incurred for designing a highway project.

Initial Predicted Design Cost (IPDC): The owner's budget for design of a highway project.

Actual Total Construction Cost (ATCC): The actual construction cost of a highway project.

Initial Predicted Construction Cost (IPCC): The owner's budget for the construction of a highway project.

Total Utility Adjustment Cost (TUAC): The total utility adjustment cost of the highway project.

Total Right-of-Way Cost (TROWC): The total cost of right-of-way acquisition of a highway project.

Total Bridge Cost (TBC): The total cost to build bridges of a highway project.

Table 4.15 Project Schedule-Related Output Parameters Profile

Name of Parameters	Units	Attributes Measured	Metric Classification	Formula	Availa-bility	Source
1. Actual Total Project Duration (ATPD)	Days	Project Schedule	Absolute	None	Yes	Owner
2. Initial Predicted Project Duration (IPPD)	Days	Project Schedule	Absolute	None	Yes	Owner
3. Actual Total Design Duration (ATDD)	Days	Design Schedule	Absolute	None	Yes	Owner
4. Initial Predicted Design Duration (IPDD)	Days	Design Schedule	Absolute	None	Yes	Owner
5. Actual Total Construction Duration (ATCD)	Days	Construc. Schedule	Absolute	None	Yes	Owner
6. Initial Predicted Construction Duration (IPCD)	Days	Construc. Schedule	Absolute		Yes	Owner
7. Project Schedule Growth	%	Project Schedule Predictability	Relative	$\frac{ATPD - IPPD}{IPPD}$	Yes	Calculate
8. Design Schedule Growth	%	Design Schedule Predictability	Relative	$\frac{ATDD - IPDD}{IPDD}$	Yes	Calculate
9. Design Schedule Factor	%	Design Schedule Predictability	Relative	$\frac{ATDD}{ATPD}$	Yes	Calculate
10. Construction Schedule Growth	%	Construc. Schedule Predictability	Relative	$\frac{ATCD-IPCD}{IPCD}$	Yes	Calculate
11. Construction Schedule Factor	%	Construc. Schedule Predictability	Relative	$\frac{ATCD}{ATPD}$	Yes	Calculate
12. Construction Speed	M/Day	Construction Speed Predictability	Relative	$\frac{TLM}{ATCD}$	Yes	Calculate
13. Project Delivery Speed	M/Day	Delivery Speed Predictability	Relative	$\frac{TLM}{ATPD}$	Yes	Calculate

TLM – Total Lane Miles

Definition of Terms:

Actual Total Project Duration (ATPD): The total duration from the beginning of detail design to turnover to owner (CII 2005).

Initial Predicted Project Duration (IPPD): The predicted duration at the time of authorization of a highway project (CII 2005).

Actual Total Design Duration (ATDD): The actual total duration to complete the detailed design of a highway project.

Initial Total Design Duration (ITDD): The owner's predicted duration to complete the detail design of a highway project.

Actual Total Construction Duration (ATCD): The actual duration to complete construction of a highway project.

Initial Predicted Construction Duration (IPCD): The owner's predicted duration to complete construction of a highway project.

Table 4.16 Project Safety-Related Output Parameters Profile

Name of Parameters	Units	Attributes Measured	Metric Classification	Formula	Availa-bility	Source
1. Total Number of Fatalities (TNF)	No.	Project Safety	Absolute	None	Yes	Owner
2. Total Number of DART	No.	Project Safety	Absolute	None	Yes	Owner
3. Total Number of Work-Zone Traffic Accidents (WZTA)	No.	Work-Zone Traffic Safety	Absolute	None	Yes	Owner
4. Fatality Rate	No./HR	Project Safety Predictability	Relative	$\frac{TNF x 200,000,000}{TSWH}$	Yes	Calculate
5. DART Rate	No./HR	Project Safety Predictability	Relative	$\frac{DART x 200,000}{TSWH}$	Yes	Calculate
6. WZT Incidents Rate	No./HR	Work-Zone Traffic Safety Predictability	Relative	$\frac{WZTA x 200,000}{TSWH}$	Yes	Calculate

TSWH – Total Site Work Hours

Definition of Terms:

Total Number of Fatalities (TNF): Total number of persons killed during the construction of a highway.

Days Away from Work Restricted Activity or Transfer (DART): The total number of incidents resulting in days away from work, restricted activity or transfer (CII, 2005).

Total Work Zone Traffic Accident (TWZTA): Total number of incidents related to a work zone traffic accident.

Fatality Rate: The number of fatalities occurring annually among 100,000 full-time workers - 2,000 hours per worker per year (CII, 2005).

DART Rate: The number of DART cases occurring annually among 100 full-time workers - 2,000 hours per worker per year (CII, 2005).

WZT Incidents Rate: The number of WZTA cases occurring annually among 100 full-time workers – 2,000 hours per worker per year.

Table 4.17 Project Quality-Related Output Parameters Profile

Name of Parameters	Units	Attributes Measured	Metric Classification	Formula	Availa-bility	Source
1. International Roughness Index (IRI)	No.	Ride Quality	Absolute	None	Yes/No	Owner
2. Total No. of Reworks (TNR)	No.	Project Rework	Absolute	None	Yes	Owner
3. Total Cost of Reworks (TCR)	No.	Project Rework	Absolute	None	Yes	Owner
4. Total No. of Reworks due to Design Problem	No.	Design Rework	Absolute	None	Yes	Owner
5. Total No. of Reworks due to Construction Problem	No.	Constr. Rework	Absolute	None	Yes	Owner
6. Total No. of Requests for Information (TRFI)	No.	Project RFI	Absolute	None	Yes	Owner
7. Total No. of Test Results (TTR)	No.	Quality Control	Absolute	None	Yes	Owner
8. Total No. of Inspection Results (TIR)	No.	Quality Assurance	Absolute	None	Yes	Owner
9. Total No. of Non-Conformance Reports (TNCR)	%	Quality Assurance	Absolute	None	Yes	Owner
10. Field Rework Factor	No./M	Project Rework Predictability	Relative	$\frac{TCR}{ATCC}$	Yes	Calculate
11. Field Rework Frequency	No./M	Project Rework Predictability	Relative	$\frac{TNR}{ATPD}$	Yes	Calculate
12. RFI Frequency	No./M	Project RFI Predictability	Relative	$\frac{TRFI}{ATPD}$	Yes	Calculate
13. Test Frequency	No./M	Project Test Predictability	Relative	$\frac{TTR}{ATPD}$	Yes	Calculate
14. Inspection Frequency	No./M	Project Inspection Predictability	Relative	$\frac{TIR}{ATPD}$	Yes	Calculate

ATPD – Actual Total Project Duration

Definition of Terms:

Rework: CII defines it as "a subset of changed work involving correction or removal of earlier work" (CII, 2005).

Total Number of Reworks (TNR): Total number of reworks that occurred in the project.

Total Cost of Reworks (TCR): Total cost associated with the reworks of the project.

Non-Conformance Report (NCR): The report submitted by the owner's verification team when the developer does not meet the specification requirement.

Request for Information (RFI): The written request for information prepared by the developer after final design to initiate the process for potential design changes or clarification during the construction period.

Table 4.18 Project Change Order-Related Output Parameters Profile

Name of Parameters	Units	Attributes Measured	Metric Classification	Formula	Availa-bility	Source
1. Total Number of Change Orders (TNCO)	No.	Project Change Order	Absolute	None	Yes	Owner
2. Total Number of Design Change Orders (TNDCO)	No.	Project Design Change Order	Absolute	None	Yes	Owner
3. Total Number of Construction Change Orders (TNCCO)	No.	Project Construc. Change Order	Absolute	None	Yes	Owner
4. Total Cost of Change Orders (TCCO)	$	Project C-O Cost	Absolute	None	Yes	Owner
5. Total Cost of Design Change Orders (TCDCO)	$	Project Design Change Order Cost	Absolute	None	Yes	Owner
6. Total Cost of Construction Change Orders (TCCCO)	$	Project Construc. C-O Cost	Absolute	None	Yes	Owner
7. Change Order Frequency	No./M	Project Change Order Predictability	Relative	$\frac{TNCO}{ATPD}$	Yes	Calculate
8. Change Order Cost Factor	%	Project C-O Cost Predictability	Relative	$\frac{TCCO}{ATPC}$	Yes	Calculate
9. Design Change Order Cost Factor	%	Project Design C-O Cost Predictability	Relative	$\frac{TCDCO}{ATPC}$	Yes	Calculate
10. Construction Change Order Cost Factor	%	Project Constr. C-O Cost Predictability	Relative	$\frac{TCCCO}{ATPC}$	Yes	Calculate
11. Design Change Order Factor	%	Project Design C-O Predictability	Relative	$\frac{TNDCO}{TNCO}$	Yes	Calculate
12. Construction Change Order Factor	%	Project Construc. C-O Predictability	Relative	$\frac{TNCCO}{TNCO}$	Yes	Calculate

ATPD – Actual Total Project Duration **ATPC –** Actual Total Project Cost

Definition of Terms:

Total Number of Change Orders (TNCO): The total number of written orders issued by the Owner to the Developer delineating any changes in the requirements of the contract documents.

Total Design Change Orders (TDCO): The total number of change order associated with the design changes.

Total Number of Construction Change Orders (TNCCO): The total number of change orders associated with the construction changes.

Total Cost of Change Orders (TCCO): The total cost associated with change orders.

Total Cost of Design Change Orders (TCDCO): The total cost of change orders associated with design.

Total Cost of Construction Change Orders (TCCCO): The total cost of change orders associated with construction.

Table 4.19 Project Claim-Related Output Parameters Profile

Name of Parameters	Units	Attributes Measured	Metric Classification	Formula	Availa-bility	Source
1. Total Number of Claims (TNC)	No.	Project Claims	Absolute	None	Yes	Owner
2. Total Number of Design Claims (TNDC)	No.	Project Design Claims	Absolute	None	Yes	Owner
3. Total Number of Construction Claims (TNCC)	No.	Project Construc. Claims	Absolute	None	Yes	Owner
4. Total Cost of Claims (TCC)	$	Project Claim Cost	Absolute	None	Yes	Owner
5. Total Cost of Design Claims (TCDC)	$	Design Claim Cost	Absolute	None	Yes	Owner
6. Total Cost of Construction Claims (TCCC)	$	Construction Claim Cost	Absolute	None	Yes	Owner
7. Claim Cost Factor	%	Project Claim Cost Predictability	Relative	$\frac{TCC}{ATPC}$	Yes	Calculate
8. Design Claim Cost Factor	%	Design Claim Cost Predictability	Relative	$\frac{TCDC}{TCC}$	Yes	Calculate
9. Construction Claim Cost Factor	%	Construction Claim Cost Predictability	Relative	$\frac{TCCC}{TCC}$	Yes	Calculate
10. Design Claim Factor	%	Design Claim Predictability	Relative	$\frac{TNDC}{TNC}$	Yes	Calculate
11. Construction Claim Factor	%	Construction Claim Predictability	Relative	$\frac{TNCC}{TNC}$	Yes	Calculate

ATPC – Actual Total Project Cost

Definition of Terms:

Claims: The separate demands by the Developer that are disputed by the Owner for any time extension beyond date sets in the agreement or payment of money or damages arising from work done on behalf of the Developer in connection with the agreement.

Design Claims: Claims related to design of a highway project.

Construction Claims: Claims related to the construction of a highway project.

5. Identification and Selection of Highway Projects for Comparison

5.1 Identification and Selection of Out-of-State Projects

Benchmarking of a highway project will have useful meaning if the project is benchmarked against similar projects. Therefore, for the benchmarking of SH 130, it is necessary to select comparable DB highway projects. For this reason, researchers identified various out-of state Federal Highway Administration (FHWA) DB highway projects approved under Special Experimental Projects No. 14 (SEP-14) as of December 31, 2002, which are possible candidates for the benchmarking of SH 130.

The initial criteria for the selection of out-of-state DB highway projects are as follows:

1. The projects should involve construction of a considerable amount of roadway.
2. The highway projects are selected from FHWA SEP-14 projects only.
3. The construction completion time of the projects should be after 2000 and should not go beyond the end of 2006.
4. The construction cost of the projects should exceed $50 million.

After the initial screening of the DB projects from the FHWA SEP-14 list, there were twenty-six out-of-state DB highway projects remaining for the final selection (FHWA, 2005). A detailed list of these highway projects is given in Appendix A.1.

The second stage of selection was done considering the following criteria:

1. The project construction cost should exceed $100 million.
2. The projects should be completed before the end of 2006.
3. There is enough information available for the projects being selected.

After the second screening, there were eight projects left for comparison purposes of benchmarking of the SH 130 project. They were:

1. US 60, Superstition Freeways, Arizona (US 60 DB Project, 2005)

2. Transportation Expansion Project (TREX), Colorado (TREX Project, 2005)
3. Route 3, Massachusetts (Route 3 Construction, 2005)
4. US 70 Hondo Valley Project, New Mexico (US 70 Hondo Valley Project, 2005)
5. Bays Parkways, South Carolina (South Carolina DOT, 2005)
6. Conway Bypass, South Carolina (South Carolina DOT, 2005)
7. I-15, Utah (FHWA, 2005)
8. Route 288, Virginia (Route 288, 2005).

A selection method was developed to choose five highly similar projects, out of these eight projects for comparison to the SH 130 project. For this, sixteen initial project characteristics were identified in order to make the final selection. These characteristics were formulated from gathered data from these project's Web sites. Then, importance weights of high (H), medium (M), and low (L) were assigned for each of these characteristics relative to its importance in the selection criteria. The project characteristics and its assigned weights for these projects including the SH 130 project are given in Table 5.1.

After this weighting process was complete, a comprehensive scoring legend was developed to assign scores to these projects relative to the SH 130 project. The scoring criteria are then drawn from the scoring legend. The detailed scoring legend for each of these project characteristics is shown in Table 5.2

The relative scores of these projects for each of the characteristics were determined by using the scoring criteria. These scores are depicted in Table 5.3.

The total weighted scores and rankings of the highway projects under consideration are shown in Table 5.4.

Table 5.1 Selecting Out-Of-State DB Highway Projects for Benchmarking

No.	Project Characteristics	WT.	Superstition Freeway, AZ	TREX, CO	Route 3, MA	US-70, Hondo Valley, NM	Bays Parkway, SC	Conway Bypass, SC	I-15, UT	Route 288, VA	SH-130 Toll Road, TX
1	Project Location (State)	H(3)	AZ	CO	MA	NM	SC	SC	UT	VA	TX
2	Project Cost (> $ 100 Million)	H(3)	184	795*	385	129	232	387	1590	236	1500
3	Project Duration (Months)	H(3)	26	60	42	38	30	36	54	31	48
4	Toll Road (T) or Non-Toll Road (NT)	M(2)	NT	NT	NT	NT	NT	NT	NT	NT	T
5	Project Funding (Public P, Public Private PP, Private PR)	L(1)	P	P	P	P	PP	PP	P	PP	P
6	Type of Construction - New (N) / Rehab (RH) / Reconstruct (RC)	H(3)	RC	RH	RC	RC	N	N	RC	N	N
7	Project Completed or Ongoing	H(3)	C	O	C	O	C	C	C	C	O
8	Total Length of Highway to be Constructed (Miles)	M(2)	13	17	21	38	20	28.5	39	17.5	49
9	Online Website Available (Y/N)	H(3)	Y	Y	Y	Y	N	N	Y	Y	Y
10	Newsletter Available on Internet (Y/N)	H(3)	Y	Y	Y	Y	N	N	N	Y	Y
11	Contract with Maintenance Option (Y/N)	L(1)	N	N	Y	N	N	N	Y	N	Y
12	No. of Design Build Contractors Involved	L(1)	2	2	1	3	1	1	3	3	3
13	Pavement Type (Concrete / Asphalt)	M(2)	A	A	A	A	A	A	C	A	C
14	Dirt Work Involved (Excavation / Embankment Filling), Y / N	L(1)	Y	Y	Y	Y	Y	Y	Y	Y	Y
15	Bridge Construction Involved (No.)	M(2)	6	22	47	7	29	31	130	25	111
16	Contract Selection Method	L(1)	BV	BV	BV	BV	BV	BV	BV	BV	BV

* Estimated Cost for Highway Only

	Score
Low	1
Medium	2
High	3

Table 5.2 Legend for Scoring Out-Of-State DB Highway Projects for Benchmarking

No.	Project Characteristics	Legend for Scoring
1	Project Location (State)	South West Region = 1, South Region = 0.80, Central Region = 0.60, West Region = 0.40, NE & MW Region = 0.20
2	Project Cost (> $ 100 Million)	= Project Cost / SH 130 Project Cost, Maximum Value =1
3	Project Duration (Months)	= Project Duration / SH 130 Project Duration, Maximum Value =1
4	Toll Road (T) or Non-Toll Road (NT)	= 1, if Toll Road, otherwise 0.
5	Project Funding (Public P, Public Private PP, Private PR)	= 1, if Public (P) Funding, otherwise 0.
6	Type of Construction - New (N) / Rehab (RH) / Reconstruct (RC)	= 1, if New Construction, otherwise 0.
7	Project Completed or Ongoing	= 1, if Project Completion till 2005 Spring, otherwise 0.
8	Total Length of Highway to be Constructed (Miles)	= Project Length / SH 130 Project Length, Maximum Value =1.
9	Online Website Available (Y / N)	= 1, if Yes, otherwise 0.
10	Newsletter Available on Internet (Y / N)	= 1, if Newsletter Available on Internet, otherwise 0.
11	Contract with Maintenance Option (Y / N)	= 1, if Contract with Maintenance Option, otherwise 0.
12	No. of Design Build Contractors Involved (Joint Venture / Single)	= 1, if Joint Venture, otherwise 0.
13	Pavement Type (Concrete / Asphalt)	= 1, if Concrete Pavement, otherwise 0.
14	Dirt Work Involved (Excavation / Embankment Filling), Y / N	= 1, if Dirt Work Involved, otherwise 0.
15	Bridge Construction Involved (No.)	= Total No. of Bridges / Total No. of Bridges in SH 130 Project, Maximum Value = 1.
16	Contract Selection Method	= 1, if Best Value Selection, otherwise 0.

Table 5.3 Relative Scores of Out-Of-State DB Highway Projects for Benchmarking

No.	Project Characteristics	WT	Superstition Freeway, AZ	TREX, CO	Route 3, MA	US-70, Hondo Valley, NM	Bays Parkway, SC	Conway Bypass, SC	I-15, UT	Route 288, VA	SH-130 Toll Road, TX
1	Project Location (State)	0.088	1.00	0.60	0.20	1.00	0.80	0.80	0.40	0.80	1.00
2	Project Cost (> $ 100 Million)	0.088	0.12	0.53	0.26	0.09	0.15	0.26	1.00	0.16	1.00
3	Project Duration (Months)	0.088	0.54	1.00	0.88	0.79	0.63	0.75	1.00	0.65	1.00
4	Toll Road (T) or Non-Toll Road (NT)	0.059	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
5	Project Funding (Public P, Public Private PP, Private PR)	0.029	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
6	Type of Construction - New (N) / Rehab (RH) / Reconstruct (RC)	0.088	0.00	0.00	0.00	0.00	1.00	1.00	0.00	1.00	1.00
7	Project Completed or Ongoing	0.088	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	Total Length of Highway to be Constructed (Miles)	0.059	0.27	0.35	0.43	0.78	0.41	0.58	0.80	0.36	1.00
9	Online Website Available (Y / N)	0.088	1.00	1.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00
10	Newsletter Available on Internet (Y / N)	0.088	1.00	1.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00
11	Contract with Maintenance Option (Y / N)	0.029	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	1.00
12	No. of Design Build Contractors Involved	0.029	1.00	1.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00
13	Pavement Type (Concrete / Asphalt)	0.059	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
14	Dirt Work Involved (Excavation / Embankment Filling), Y / N	0.029	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
15	Bridge Construction Involved (No.)	0.059	0.05	0.20	0.42	0.06	0.26	0.28	1.00	0.23	1.00
16	Contract Selection Method	0.029	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 5.4 Total Weighted Scores of Out-Of-State DB Highway Projects for Benchmarking

No.	Project Characteristics	WT.	Superstition Freeway, AZ	TREX, CO	Route 3, MA	US-70, Hondo Valley, NM	Bays Parkway, SC	Conway Bypass, SC	I-15, UT	Route 288, VA	SH-130 Toll Road, TX
1	Project Location (State)	0.088	0.09	0.05	0.02	0.09	0.07	0.07	0.04	0.07	0.09
2	Project Cost (> $ 100 Million)	0.088	0.01	0.05	0.02	0.01	0.01	0.02	0.09	0.01	0.09
3	Project Duration (Months)	0.088	0.05	0.09	0.08	0.07	0.06	0.07	0.09	0.06	0.09
4	Toll Road (T) or Non-Toll Road (NT)	0.059	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
5	Project Funding (Public P, Public Private PP, Private PR)	0.029	0.03	0.03	0.03	0.03	0.00	0.00	0.03	0.00	0.03
6	Type of Construction - New (N) / Rehab (RH) / Reconstruct (RC)	0.088	0.00	0.00	0.00	0.00	0.09	0.09	0.00	0.09	0.09
7	Project Completed or Ongoing	0.088	0.09	0.00	0.09	0.09	0.09	0.09	0.09	0.09	0.09
8	Total Length of Highway to be Constructed (Miles)	0.059	0.02	0.02	0.03	0.05	0.02	0.03	0.05	0.02	0.06
9	Online Website Available (Y / N)	0.088	0.09	0.09	0.09	0.09	0.00	0.00	0.09	0.09	0.09
10	Newsletter Available on Internet (Y / N)	0.088	0.09	0.09	0.09	0.09	0.00	0.00	0.00	0.09	0.09
11	Contract with Maintenance Option (Y / N)	0.029	0.00	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.03
12	No. of Design Build Contractors Involved	0.029	0.03	0.03	0.00	0.03	0.00	0.00	0.03	0.03	0.03
13	Pavement Type (Concrete / Asphalt)	0.059	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06
14	Dirt Work Involved (Excavation / Embankment Filling), Y / N	0.029	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
15	Bridge Construction Involved (No.)	0.059	0.00	0.01	0.02	0.00	0.02	0.02	0.06	0.01	0.06
16	Contract Selection Method	0.029	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
			0.55	**0.51**	**0.55**	**0.60**	**0.41**	**0.45**	**0.70**	**0.62**	**1.00**
	RANK		**4**	**6**	**4**	**3**	**8**	**7**	**1**	**2**	

5.2 Identification and Selection of In-State Projects

For comparison purposes, both DB and DBB highway projects were selected from the ongoing highway projects being built in Texas. Ultimately, the largest ongoing DBB projects were selected for the comparison. The selected in-state DBB highway projects are:

1. High Five Project – Construction of 5 Level Interchange, Dallas
2. Corridor Program of Katy Freeway Project – Reconstruction of IH-10, including the interchange on IH-610, Houston
3. Corridor Program of IH-10 Interchange Project, San Antonio
4. Corridor Program of IH-410 Interchange Project, San Antonio
5. Corridor Program of SH 45 N and Loop 1 Project, Austin.

Aside from SH 130, there are only two DB highway projects currently being built in the state of Texas:

1. US 183A Project, Austin
2. SH 45 SE Project, Austin.

The framework of comparison projects for benchmarking the SH 130 project is depicted in Figure 5.1.

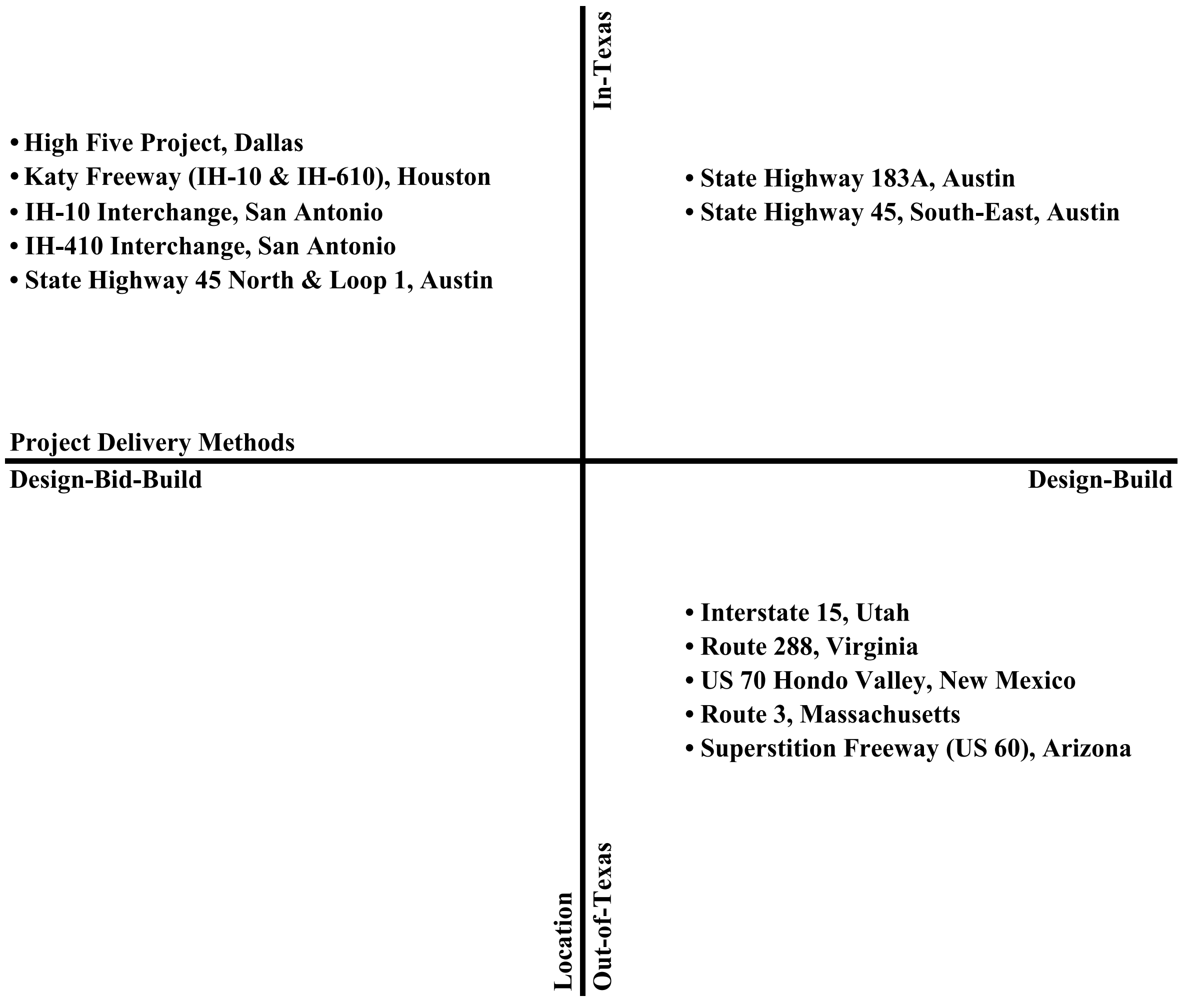

Figure 5.1 Framework for Comparisons with SH 130

6. Data Collection

6.1 Preliminary Data Collection

The collection of data for the targeted projects for comparison has already started. Most of the in-state DBB project data has been collected from project websites or TxDOT websites. The data collected thus far is related to input parameters and is shown in Tables 6.1 and 6.2. Continuing data collection for these targeted in-state and out-of-state highway projects will be carried out simultaneously.

Data will be collected via the following data collection procedures:

1. Information from Internet
2. Structured interviews via telephone
3. Interview guides via email.

Prior to phone and email queries, interview guides and survey forms will be structured in such a way that the required data can be collected readily, efficiently, and accurately. The initial draft format of an interview guide to extract data is included in Appendix 2.

6.2 Plan for Continuing Data Collection and Analysis

Data for the out-of-state and in-state highway projects will be collected simultaneously. Contact persons for obtaining information for all of these projects have been identified. First, the persons who are in charge of these projects will be contacted. Then interview guides will be sent to the people who have accurate information on specific project disciplines. After all these interview guides are collected, the missing information will be determined. The missing information will be gathered either by telephone interview or in person. Data collection will continue until the end of 2007.

Table 6.1 Preliminary Input Parameter Data of In-State DBB Highway Projects for Benchmarking

No.	Input Parameters	Mega Project	Corridor Program (IH-10, Katyfreeway, Houston)								
		Dal H-5, TX (5 Level Interchange Cons.)	IH-10 (Contract A, Ft. Bend County Line to E of Peek)	IH-10 (Contract B, E of Peek to W of SH 6)	IH-10 (Contract C1, W of SH 6 to E of Eldridge)	IH-10 (Contract C2, E of Eldridge to E of Kirkwood)	IH-10 (Contract D, E of Kirkwood to E of BW8)	IH-10 (Contract E1, E of BW8 to E of Campbell)	IH-10 (Contract E2, E of Campbell to E of Silber)	IH-610 (Contract F, E of Silber to E of IH 610 & Interchange)	IH-10 (Contract G, E of IH 610 to W of Washington)
1	***Project Size, Type, and Location***										Bid in 2007
	1.1 Project Bid Cost ($ MM)	261	83	208	153	84	250	204	158	263	38
	1.2 Project Bid Duration (Days)	1800	921	930		1,100	1,351	1,186	1,192	1,359	
	1.3 Location Type (Urban / Rural)	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban	Urban
	1.4 New Construction / Rehabilitation / Reconstruction / Expansion	Exp.	Reconst.	Reconst.	Reconst.	Reconst.	Reconst.	Reconst.	Reconst.	Reconst.	Reconst.
	1.5 Construction Under Traffic (Y / N)										
	1.6 Toll Road (Y / N)	Y	Y	Y		Y	Y	Y	Y	Y	Y
2	***Contract Delivery Methods***										
	2.1 Contractor Selection Method	Low Bid	Low Bid	Low Bid	Low Bid	Low Bid	Low Bid	Low Bid	Low Bid	Low Bid	Low Bid
	2.2 Type of Contract	DBB	DBB	DBB	DBB	DBB	DBB	DBB	DBB	DBB	DBB
	2.3 ROW Acquired Before Contract (Y / N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	2.4 Utility Adjustment Before Contract (Y / N)	N	N	N		N	N			N	N
	2.5 Liquidated Damage Amount ($ / day)	2,700	1,900	1,900		1,650	1,650	1,650	1,650	1,900	
	2.6 One-Time Bonus ($)										
	2.7 Incentive for Early Substantial Completion ($ / day)		Max. $3.2 MM	Max. $5.5 MM			Max. $13.3			Max. $11.7 MM	
	2.8 Disincentive for Late Completion ($ / day)		$5K to $50K	$5K to $50K			$5K to $75K			$5K to $75K	
	2.9 Lane Rental ($ / Hr / L)										
	2.10 Operation and Maintenance Included	N	N	N		N	N	N	N	N	
	2.11 Type of Specification (Performance / Prescriptive)										
3	***Organizational Approaches***										
	3.1 Formalized Partnering										
	3.2 Alignment										
	3.3 Pre-Project Planning										
	3.4 Involvement of GEC										
	3.5 No. of Subcontracts										
	3.6 Co-Location										
	3.7 Private Construction Manager's Involvement										
	3.8 Change Management										
	3.9 Communication										
	4.10 Value Engineering										
	4.11 Constructability										
4	***Work Processes***										
	4.1 Use of Latest Technology in Construction										
	4.2 Use of Information Technology										
	4.3 Project Web Portal	Y	Y	Y	Y	Y	Y	Y	Y	Y	
5	***Project Calendar***										
	5.1 Work Week (4-5-6-7 days)										
	5.2 Work Shifts (Single / Multiple)										
	5.3 Winter Severity										
	5.4 Major Delay										
6	***Environmental Area***										
	6.1 No. of Environmental Delays										
	6.2 SW3P Issues					Y					
	6.3 Change of Alignment (Within Zone, Stick with it)										
	6.4 Wetlands Affected										
	6.5 No. of Water Crossings										
	6.6 No. of Required Remediation										
	6.7 No. of Endangered Species										
	6.8 No. or Areas of Historical Properties										
	6.9 WPAP for Recharge Zones (Coast or Sand)										
	6.10 Archeo - Paleo										

Table 6.1 Preliminary Input Parameter Data of In-State DBB Highway Projects for Benchmarking (continued)

No.	Input Parameters	Mega Project	Corridor Program (IH-10, Katyfreeway, Houston)								
		Dal H-5, TX (5 Level Interchange Cons.)	IH-10 (Contract A, Ft. Bend County Line to E of Peek)	IH-10 (Contract B, E of Peek to W of SH 6)	IH-10 (Contract C1, W of SH6 to E of Eldridge)	IH-10 (Contract C2, E of Eldridge to E of Kirkwood)	IH-10 (Contract D, E of Kirkwood to E of BW8)	IH-10 (Contract E1, E of BW8 to E of Campbell)	IH-10 (Contract E2, E of Campbell to E of Silber)	IH-610 (Contract F, E of Silber to E of IH 610 & Interchange)	IH-10 (Contract G, E of IH 610 to W of Washington)
7	***Right of Way***										
	7.1 Total ROW Parcels										
	7.2 Procurement Responsibility										
	7.3 % of Condemnations										
	7.4 % of Administration Settlement Before or After Project Start										
	7.5 ROW Budget ($)										
8	***Utility Adjustments***										
	8.1 No. of Utility Adjustments										
	8.2 Total Length of Utility Adjustments										
	8.3 Sub-surface Utility Engineering (SUE) Budget ($)										
	8.4 Utility Adjustment Budget ($)										
	8.5 Utility Adjustment Before or After Contract (In Scope of Work)	After	After	After		After	After	After	After	After	
9	***Structures***										
	9.1 Total No. of Interchanges	1	None	None	None	None	None	None	None	1	
	9.2 Level of Interchange	5								4	
	9.3 Total No. of Bridges	35	3	6	10	4	14	12	13	4	
	9.4 Bridge of Dominant Type (Steel vs. Concrete)	Concrete	Concrete	Concrete		Concrete	Concrete	Concrete	Concrete	Concrete	
	9.5 Area of Bridge Deck (SFT)	2,084,837	613,780	217,648		207,678	970,832	550,325	603,054	1,510,568	
	9.6 Total Length of Bridge (LF)										
	9.8 Average Height of Bridge (FT)	120									
	9.9 Maximum Height of Bridge										
	9.10 Total Length of Box Culvert (LF)	1,495	5,167	41,059		13,195	28,064	33,051	11,585	9,137	
	9.11 Total Length of Pipe Culvert (LF)	67,059	473	28,408		20,302	48,875	41,333	33,709	44,450	
	9.12 No. of Frontage Roads		3	6	2	2		4	4		
	9.13 No. of Freeway Ramps				8	8		14	12		
	9.14 No. of Toll Plazas										
10	***Surface Courses and Pavements***										
	10.1 Pavement Type (Asphalt / PCC / RCC)	RCC	RCC	RCC		RCC	RCC	Asph/RCC	Asph/RCC	Asph/RCC	
	10.2 Average Thickness of Pavement (Inches)	12.8	12.4	15.2		13.5	12.8	A-1.5,C-13.7	A-1.5,C-13.5	A-4,C-13	
	10.3 Total Area of Pavement (SY)	678,582	457,076	616,314		367,845	464,751	737,841	695,770	544,640	
	10.4 Total Length of Highway (Miles)	3.387	2.94	6.91	2.27	1.80	1.99	2.65	2.46	3.63	1.65
	10.5 Total Length of Highway (Lane Miles)										
	10.5.1 Total Length of Main Lanes (Miles)										
	10.5.2 Total Length of Frontage Road Lane (Miles)										
	10.5.3 Total Length of HOV Lane (Miles)										
	10.5.4 Total Length of Toll Lane (Miles)										
11	***Earthwork***										
	11.1 Earthwork Excavation (Cu Yd)	988,315	413,487	432,720		172,297	325,861	222,235	366,144	650,664	
	11.2 Embankment Filling (Cu Yd)	1,263,489	382,133	1,000,203		485,160	448,304	1,335,643	1,498,608	573,001	
	11.3 Earthwork Excavation Type (% of Rock and Dirt)										
12	***Intelligent Transportation Systems***		Y	Y		Y	Y	Y	Y	Y	
	12.1 Type of ITS Installed										
	12.2 Total ITS Budget ($)										
13	***Owner Staffing***										
	13.1 Total F.T.E.										
	13.2 Type of F.T.E										

Table 6.2 Preliminary Input Parameter Data of In-State DBB Highway Projects for Benchmarking

No.	Input Paratmeters	Corridor Program (IH-10 Interchange, S. A.)		IH-410 Interchange S.A.	Corridor Program (SH 45 N & Loop 1, Austin)							
		IH-10 Interchange, San Antonio, McCarthy Building	IH-10 Interchange, San Antonio, Williams Brothers	IH-410 Interchange, San Antonio	Loop 1, Section 1 & 2 (Zachry/Gilbert Constructors)	SH 45 N/Loop 1, Section 3 (Zachry / Gilbert Constructors)	SH 45 N/I 35, Section 4A & 4B (Archer-Western Constructors, Ltd.)	SH 45 N, Section 5 (Zachry Construction Corporation)	SH 45 N, Section 6 (Austin Bridge & Road, L.P.)	SH 45 N / RM 620, Section 7 (Granite Construction & J.D. Abrams, L.P.)	SH 45 N / US 183, Section 8 (Austin Bridge & Road, L.P.)	SH 45 N, Section 9 (Zachry Construction Corporation)
1	***Project Size, Type, and Location***											
	1.1 Project Bid Cost ($ MM)	49.5	82	155	108	81	103	38	34	63	74	Not Done
	1.2 Project Bid Duration (Days)	805	1136	1023		804	1003	783	565	792		
	1.3 Location Type (Urban / Rural)	Urban	Urban	Urban		Urban	Urban	Urban	Urban	Urban		
	1.4 New Construction / Rehabilitation / Reconstruction / Expansion					New	New	New	New	New		
	1.5 Construction Under Traffic Y / N)											
	1.6 Toll Road (Y / N)	N	N	N		Y	Y	Y	Y	Y		
2	***Contract Delivery Methods***											
	2.1 Contractor Selection Method	Low Bid	Low Bid	Low Bid		Low Bid	Low Bid	Low Bid	Low Bid	Low Bid		
	2.2 Type of Contract	DBB	DBB	DBB		DBB	DBB	DBB	DBB	DBB		
	2.3 ROW Acquired Before Contract (Y / N)	Y	Y	Y		Y	Y	Y	Y	Y		
	2.4 Utility Adjustment Before Contract (Y / N)	N	N	N		N	N	N	N	N		
	2.5 Liquidated Damage Amount ($ / day)	2,700	1,900	1,650		1,900	1,900	1,900	1,650	1,900		
	2.6 One-Time Bonus ($)						1,700					
	2.7 Incentive for Early Substantial Completion ($ / day)						10,000					
	2.8 Disincentive for Late Completion ($ / day)						31,900					
	2.9 Lane Rental ($ / Hr / L)											
	2.10 Operation and Maintenance Included	N	N	N		N	N	N	N	N		
	2.11 Type of Specification (Performance / Prescriptive)											
3	***Organizational Approaches***											
	3.1 Formalized Partnering											
	3.2 Alignment											
	3.3 Pre-Project Planning											
	3.4 Involvement of GEC											
	3.5 No. of Subcontracts											
	3.6 Co-Location											
	3.7 Private Construction Manager's Involvement											
	3.8 Change Management											
	3.9 Communication											
	3.10 Value Engineering											
	3.11 Constructability											
4	***Work Processes***											
	4.1 Use of Latest Technology in Construction											
	4.2 Use of Information Technology											
	4.3 Project Web Portal											
5	***Project Calendar***											
	5.1 Work Week (4-5-6-7 days)											
	5.2 Work Shifts (Single / Multiple)											
	5.3 Winter Severity											
	5.4 Major Delay											
6	***Environmental Area***											
	6.1 No. of Environmental Delays											
	6.2 SW3P Issues											
	6.3 Change of alignment? (Within Zone, Stick with it)											
	6.4 Wetlands Affected											
	6.5 No. of Water Crossings											
	6.6 No. of Required Remediation											
	6.7 No. of Endangered Species											
	6.8 No. or Area of Historical Properties											
	6.9 WPAP for Recharge Zones (Coast or Sand)											
	6.10 Archeo - Paleo											

Table 6.2 Preliminary Input Parameter Data of In-State DBB Highway Projects for Benchmarking (continued)

No.	Input Parameters	Corridor Program (IH-10 Interchange, S. A.)		IH-410 Interchange S.A.	Corridor Program (SH 45 N & Loop 1, Austin)							
		IH-10 Interchange, San Antonio, McCarthy Building	IH-10 Interchange, San Antonio, Williams Brothers	IH-410 Interchange, San Antonio	Loop 1, Section 1 & 2 (Zachry / Gilbert Constructors)	SH 45 N / Loop 1, Section 3 (Zachry / Gilbert Constructors)	SH 45 N / I 35, Section 4A & 4B (Archer-Western Constructors, Ltd.)	SH 45 N, Section 5 (Zachry Construction Corporation)	SH 45 N, Section 6 (Austin Bridge & Road, L.P.)	SH 45 N / RM 620, Section 7 (Granite Construction & J.D. Abrams, L.P.)	SH 45 N / US 183, Section 8 (Austin Bridge & Road, L.P.)	SH 45 N, Section 9 (Zachry Construction Corporation)
7	***Right of Way***											
	7.1 Total ROW Parcels				37				132			
	7.2 Procurement Responsibility											
	7.3 % of Condemnations											
	7.4 % of Administration Settlement Before or After Project Start											
	7.5 ROW Budget ($)											
8	***Utility Adjustments***											
	8.1 No. of Utility Adjustments											
	8.2 Sub-surface Utility Engineering (SUE) Budget ($)											
	8.3 Utility Adjustment Budget ($)											
	8.4 Utility Adjustment Before or After Contract (In Scope of Work	After	After	After		After	After	After	After	After		
9	***Structures***											
	9.1 Total No. of Interchanges						2					
	9.2 Level of Interchange											
	9.3 Total No. of Bridges	7	12	19				4	1			
	9.4 Bridge of Dominant Type (Steel vs. Concrete)	Concrete	Concrete	Concrete		Concrete	Concrete	Concrete	Steel	Concrete		
	9.5 Area of Bridge Deck (SFT)	437,277	820,341	1,058,042		1,435,111	1,591,222	233,234	43,100	404,719		
	9.6 Total Length of Bridge (LF)											
	9.7 Total Length of Bridge Girder (LF)	87,598	84,256	119,684		175,325	192,678	30,568		51,341		
	9.8 Average Height of Bridge (FT)											
	9.9 Maximum Height of Bridge											
	9.10 Total Length of Box Culvert (LF)	350	4,191	12,204		7,264	3,543	6,969	5,055	10,528		
	9.11 Total Length of Pipe Culvert (LF)	9,985	11,421	22,896		17,097	21,182	22,928	20,785	26,818		
	9.12 No. of Frontage Roads											
	9.13 No. of Freeway Ramps											
	9.14 No. of Toll Plazas						4		4	4		
10	***Surface Courses and Pavements***											
	10.1 Pavement Type (Asphalt / PCC / RCC)	Asph/RCC	Asph/RCC	Asph/RCC		Asph/RCC	Asph/RCC	Concrete	Concrete	Asph/ RCC		
	10.2 Average Thickness of Pavement (Inches)	A-7,C-13	A-2.5, C-13	A-2, C-8		A-1.5,C-11	A-2, C-11	C-11	C-11	A-2, C-11		
	10.3 Total Area of Pavement (SY)	186,784	340,689	441,640		128,288	226,495	116,491	159,620	255,039		
	10.4 Total Length of Highway (Miles)				3.50	2.80	2.10	1.40	1.50	2.60	2.80	1.60
	10.5 Total Length of Highway (Lane Miles)											
	10.5.1 Total Length of Main Lanes (Miles)											
	10.5.2 Total Length of Frontage Road Lane (Miles)											
	10.5.3 Total Length of HOV Lane (Miles)											
	10.5.4 Total Length of Toll Lane (Miles)											
11	***Earthwork***											
	11.1 Earthwork Excavation (Cu Yd)	178,180	745,514	169,975		246,199	142,857	309,678	807,396	317,852		
	11.2 Embankment Filling (Cu Yd)	178,473	491,921	158,442		700,064	429,560	400,460	86,792	668,717		
	11.3 Earthwork Excavation Type (% of Rock and Dirt)											
12	***Intelligent Transportation Systems***											
	12.1 Type of ITS Installed											
	12.2 Total ITS Budget ($)											
13	***Owner Staffing***											
	13.1 Total F.T.E.											
	13.2 Type of F.T.E											

7. Preliminary Conclusions

The preliminary conclusions are:

- The research methodology for the benchmarking of SH 130 is based on project "input" and "output" parameters.
- The input parameters are structured according to the highway project construction work areas.
- The output parameters, know as project performance metrics, are related to key performance measures of highway projects.
- The SH 130 project will be benchmarked with five comparable out-of-state DB (FHWA) highway projects.
- The SH 130 project will be benchmarked with two ongoing in-state DB highway projects.
- The SH 130 project will be benchmarked with five large ongoing in-state DBB highway projects.
- The input and output parameters for the benchmarking of the SH 130 project will be adjusted according to data availability during the data collection phase.
- Data collection interview guides will be finalized by Fall 2005.
- The detailed data collection for this benchmarking purpose will be started immediately and the final findings will be presented in the final report.
- Researchers expect to be able to obtain all required input and output data of selected highway projects for analysis purpose.

References

Benchmarking and Best Practices, American Product and Quality Services, http://www.apqc.org/portal/apqc/site/generic?path=/site/benchmarking/overview.jhtml, accessed May 2005.

Booz Allen Hamilton. *Research for customer-driven benchmarking of maintenance activities*. National Cooperative Highway Research and Transportation Research Board, 2003.

Brunso, Torkild P., and Siddiqi, Khalid M. "Using benchmarks and metrics to evaluate project delivery of environmental restoration programs." *Journal of Construction Engineering and Management,* ASCE, Vol. 129, No. 2 (2004):119-130.

Camp, R. C. *Benchmarking: The search for industry best practices that lead to superior performance.* Milwaukee: ASQC Quality Press, 1989.

Construction Industry Institute (CII). *Benchmarking & Metrics, Value of best practices report*. The Benchmarking and Metrics Committee, CII, BMM 2003-2004.

CII and NIST. "Measuring the impacts of delivery system on project performance – design-build and design-bid-build." Report No. BMM 2002-10.

CII Benchmarking & Metrics, http://www.cii-benchmarking.org, accessed May, 2005.

CII, Benchmarking & Metrics, Owner's Questionnaire, http://cii-benchmarking.org/downloads/Owner_v7.3.pdf, accessed 2004.

Dallas High Five Project website, http://www.dallashighfive.org, accessed 2004-2005.

Design-Build Institute of America website, http://www.dbia.org, accessed May 2005.

Federal Highway Administration website, http://www.fhwa.dot.gov/programadmin/contracts/sep14a.htm, accessed January 2005.

Federal Highway Administration website, http://www.fhwa.dot.gov/utdiv/projects/i15brief.htm, accessed 2004-2005.

Gibson, G. Edward, Jr. and Walewski, John. *Project delivery methods and contracting approaches: Assessment and design-build implementation guidance*. Research Report Number 2129-1, Center for Transportation Research, Appendix E, 2001.

Katy Freeway website, http://www.katyfreeway.org, accessed 2004-2005.

Konchar, Mark, and Sanvido,Victor. "Comparison of U.S. project delivery systems." *Journal of Construction Engineering and Management*, ASCE, Vol. 124, No. 6 (1998): 435-444.

Koppinen, Tiina, and Lahdenpera, Pertti. *The current and future performance of road project delivery methods*, VTT Building and Transport. Finland: VTT Publications 549, 2004.

Lone Star Infrastructure website for the SH 130 project, http://www.sh130.com/news/, accessed 2004-2005.

O'Connor, James T., and Gibson, Edward G., Jr. *Monitoring and evaluation of SH 130 project construction.* Project Proposal, Center for Transportation Research, The University of Texas at Austin, 2003.

O'Connor, James T., Satori, Thomas R., and Pugh, Timothy E. *Navy demonstration project: Test bed for selected CII principles*. Austin: Construction Industry Institute, 1995.

Project Reports-Current and Future, Texas Department of Transportation website, http://www.dot.state.tx.us/business/projectreports.htm, accessed 2004-2005.

Route 288 Virginia website, http://www.route288.com, accessed 2004-2005.

Route 3 Construction in Massachusetts website, http://www.route3construction.com, accessed 2004-2005.

Sanvido, Victor., Grobler, Francois., Parfitt, Kevin., Guvenis, Moris., and Coyle, Michael. "Critical success factors for construction projects." *Journal of Construction Engineering and Management,* ASCE, Vol. 118, No. 1 (1992): 94-111.

Shields, David R. *Construction success of projects*. Ph.D. Dissertation, The University of Texas at Austin, 2002.

South Carolina Department of Transportation website, http://www.scdot.org, accessed 2004-2005.

US 60 Design-Build Project, Sponsored by the Arizona Department of Transportation, http://www.superstitionfreeway.com, accessed 2004-2005.

Texas Department of Transportation, Texas Toll-Ways website, http://www.texastollways.com, accessed May 2005.

Transportation Expansion Project website, http://www.trexproject.com, accessed 2004-2005.

United States Environmental Protection Agency website, http://www.epa.gov/reg3wapd/stormwater/pdfs/construction.pdf, accessed July 2005.

US 70, Hondo Valley Project in New Mexico website, http://www.us70hondovalley.com, accessed 2004-2005.

Warne, Thomas R. *Design Build Contracting for Highway Projects: A Performance Assessment.* Tom Warne & Associates, LLC., May 2005.

Appendix A:

Description of DB Highway Projects

(FHWA, SEP-14, > $50 MM Project Cost) for Consideration

Table A.1 Description of DB (FHWA) Highway Projects (> $50 MM) for Considerations

No.	State	Name of Project	Date Started	Date Completed	Construction Cost ($)	Project Description
1	Arizona	Tempe - Mesa Project, US 60 Superstition Freeway Widening Project	Jun-01	Summer 03	184,292,800	Adding additional lanes including HOV and auxiliary lanes between IH-10 and Val Vista Road.
2	Arizona	Phoenix Project: SR 51 HOV Lanes	Jan-03	Mar-04	75,685,000	Adding HOV lane to northbound and southbound State Route 51 from IH-10 to Shea Boulevard
3	Colorado	Transportation Expansion Project (TREX)	Fall 2001	Sep-06	1,670,000,000 (795,000,000 for highway construction)	Construction of 19 miles of light railroad and 17 miles of highway through southeast Denver, Aurora, Greenwood Village, Centinnial, Lone Trees
4	Florida	IH-4 Reconstruction	NA	NA	72,760,000	Adding lanes and reconstruction
5	Florida	IH-4 Add Lanes and Rehabilitation Project	NA	NA	59,600,000	Adding lanes and rehabilitation
6	Florida	IH-95 Widening	NA	NA	67,300,000	Widening of existing IH-95
7	Florida	IH-4 Interchange (Major)	NA	NA	62,150,000	Interchange construction
8	Georgia	IH-75 Turner Crisp Cos., SR 159 to SR 300	Nov-00	NA	51,900,000	Construction of 14.5 miles of road
9	Georgia	IH-75 Lowndes Co. SR-133 to Cook Co. Line	NA	NA	67,000,000	Construction of 13.7 miles of road
10	Indiana	IH-65 Reconstruction & Adding Lane	Mar-00	Oct-01	76,500,000	Reconstructing and adding lanes from Cold Spring to IH-465 Indianapolis, Marion County
11	Indiana	IH-465 / IH-70 Reconstruction of Interchange	Mar-01	Nov-02	67,100,000	Reconstruction of interchange in Indianapolis, Marion County
12	Massachussets	Route 3, North from Route 128 to the NH border	Aug-00	Mar-04	385,000,000	Reconstruction of 21 miles road
13	Minnesota	Highway 52 Reconstruction Project	Summer 2002	Aug-06	220,000,000	Reconstruction of road from Highway 63 to 85th St. NW in Rochester.

Table A.1 Description of DB (FHWA) Highway Projects (> $50 MM) for Considerations (continued)

No.	State	Name of Project	Date Started	Date Completed	Construction Cost ($)	Project Description
14	New Jersey	Route 29 Improvement	Sep-97	Dec-00	70,930,000	Information not available
15	New Jersey	Enhanced I & M Stations	Aug-98	NA	63,156,000	Information not available
16	New Mexico	US Hondo Valley Project	Aug-01	Jan-05	129,000,000	Construction of US 70, which includes 38 miles of four-lane highway beginning from east of Rudoso Downs to east of community of Riverside
17	North Carolina	Reconstruction of IH-77	Nov-01	Oct-04	70,900,000	Information not available
18	North Carolina	IH-26 Reconstruction	Not awarded		83,700,000	Reconstruction from NC 225 to NC 280
19	North Carolina	Widening of IH-85	Nov-02	Oct-05	87,700,000	Rehabilitation and widening of IH-85 from US 29 to NC 73 in Mecklenburg County
20	North Carolina	US 64 Knightdale Bypass	Jun-02	Aug-05	131,000,000	Information not available
21	South Carolina	Conway Bypass	Apr-95	Dec-01	386,300,000	28.5 miles; 4 lanes from US 501, 10 miles north of Conway, to the Carolina Bays Parkway, and 6 lanes from there to US 17 in the Myrtle Beach area
22	South Carolina	Carolina Bays Parkway	Mar-00	Jun-02	225,400,000	6 lanes from US 501 to SC 9, north/south highway intersecting the Conway Bypass in the Myrtle Beach area.
23	South Carolina	SC 170 Widening	Sep-00	Mar-03	105,000,000	12.5 miles; widening to 4 lanes west of Beaufort from east of the SC 462 to just west of S 761 (W.L. Alston Drive) and the replacement of bridges over the Chechessee and the Broad Rivers.
24	Utah	IH-15 Reconstruction	Jun-96	NA	1,325,000,000	Information not available
25	Utah	12300 South Interchange	Jul-02	NA	65,500,000	Information not available
26	Virginia	Route 288 Reconstruction	Mar-01	Oct-03	236,000,000	Reconstruction between IH-64/288 interchange and IH-64 to Rt. 250 connection

Appendix B:

"Plan" Product

Benchmarking SH 130 Project

Interview Guide

We would like to thank you in advance for the time and effort involved in your agency's participation in this research.

This interview guide is divided into four sections; Project General Information; Project Characteristics; Project Performances; and Stakeholders' Success. If not enough space is provided for the brief questions, please feel free to attach extra sheets to the document.

In the questions, we ask for detailed information on project characteristics and performance. Please do what you can to assemble this information as fully as possible. Your detailed responses will allow us to understand to what extent these project characteristics and performance measurements affect the benchmarking of highway projects.

The confidentiality of this interview will be maintained. This interview data will not be placed in any permanent record, and will be destroyed when no longer needed by the researchers. The identity of person who provided all this information will remain anonymous. The data obtained during this interview will not be linked in any way to participants' names.

Please return this questionnaire via email, by fax, or by mail to the following address:

Pramen P. Shrestha
Graduate Research Assistant,
The University of Texas at Austin
Civil Engineering Department ARE/CEPM/ICAR
University Station C1752
Austin, Texas 78712-0276
Email: pramen@mail.utexas.edu
Fax Number: 512-471-3191

Section 1:

1 ***Project General Information***

1.1 *Name of Owner Organization:* ______________________

1.2 *Name of Project:* ______________________

1.3 *Project ID:* ______________________

1.4 *Project Description:* ______________________

1.5 *Starting Location:* ______________________

1.6 *Ending Location:* ______________________

1.7 *Contact Person (Name of person filling this questionnaire):* ______________

1.8 *Contact Person's Phone:* ______________________

1.9 *Contact Person's Fax:* ______________________

1.10 *Contact Person's Email Address:* ______________________

1.11 *Contact Person's Role / Title in this Project:* ______________________

1.12 *Project web address:* ______________________

1.13 *Date of Assessment:* ______________________

Section 2:

2 Project Characteristics

2.1 *Current State of Project*

2.1.1 Describe current state of this highway project.

Completed on ______________________

Operational from ______________________

OR

% of completed ______________________

Current planned completion date ______________________

2.2 *Type of Work and Location*

2.2.1 Where is this highway project located?

☐ Urban ☐ Rural

☐ Other ______________________

2.2.2 Describe the nature of this project.

☐ New green field construction ☐ Rehabilitation

☐ Reconstruction ☐ Expansion

☐ Other ____

2.2.3 Was this highway project constructed while maintaining traffic flow?

☐ Yes ☐ No

2.3 *Project Scope*

Please provide following project data.

2.3.1 Total length of road __________________________________ Miles

2.3.2 Total length of freeway main lanes _________________ Lane miles

2.3.3 Total length of frontage roads – both side ____________ Lane miles

2.3.4 Total length of HOV lanes _______________________ Lane miles

2.3.5 Total number of highway interchanges _______________________

2.3.6 Total number of frontage road intersections ___________________

2.3.7 Total number of freeway ramps ______________________________

2.3.8 Total number of bridge spans _______________________________

2.3.9 Total number of concrete bridge spans _______________________

2.3.10 Total number of steel bridge spans __________________________

2.3.11 Total area of bridge deck ______________________________(SF)

2.3.12 Number of rail road crossings _______________________________

2.3.13 Number of water crossings _________________________________

2.3.14 Total length of roadway tunnels ________________________ Miles

2.3.15 Total length of drainage tunnels ________________________ Miles

2.3.16 Total length of box culvert _______________________________ LF

2.3.17 Total length of pipe culvert ______________________________ LF

2.3.18 Total number of toll plazas __________________________________

2.3.19 Pavement types (concrete or asphalt or combination) ____________

2.3.20 Total quantity of earthwork excavation _____________________ CY

2.3.21 Percentage of rock excavation _____________________________ %

2.3.22 Total quantity of embankment filling _____________________ CY

2.4 *Contract*

2.4.1 What type of contract delivery method was used to deliver this project?

- ☐ Design-Bid-Build (DBB) ☐ Design-Build (DB)
- ☐ Design-Build-Operate-Maintain (DBOM)
- ☐ Finance-Design-Build-Operate-Maintain (FDBOM)
- ☐ Other ________________________

2.4.2 How many previous projects had been design-build (D-B)?

- ☐ One ☐ Two
- ☐ Three ☐ Three plus

2.4.3 How was the contractor (developer) selected?

- ☐ Based on unit prices ☐ Negotiation
- ☐ Best Value ☐ A+ B Bidding
- ☐ Qualifications
- ☐ Other ________________________________

2.4.4 What was the rate of liquidated damages in this contract?

- ☐ US $__________________________ per day or per month
- ☐ No liquidated damage provision in contract

2.4.5 Was there any schedule performance bonus in this contract? If yes, how much was it?

- ☐ Yes ____

  ____

  ____

  (Total amount in US $; details of system)
- ☐ No

2.4.6 Were there any other disincentives for late completion? If yes, how much was it?

- ☐ Yes ____

  ____

  ____

  ($/day or $/month; details of system)
- ☐ No

2.4.7 Was there any lane rental provision in this contract? If yes, what was the fee assessed for each lane closure?

☐ Yes ____
(US $/lane-hour or $/lane-day)

☐ No

2.4.8 What approximate percentage of design was completed when construction contract was awarded?

____
(% of design complete)

2.4.9 What types of specifications were used to construct this highway?

☐ Performance spec ☐ Prescriptive spec

☐ Blend of above ☐ Other ____________________

2.5 *Organizational Approaches*

2.5.1 Was there a partnering facilitator hired and used for this project?

☐ Yes ☐ No (Go to 2.5.3)

2.5.2 If yes, what was the frequency of partnering sessions (or progress evaluation)?

☐ ____
(Number of times per month or per year)

☐ None

2.5.3 How would you characterize environmental assessment done during pre-project planning of this project?

☐ High level ☐ Medium level

☐ Low level

2.5.4 How would you characterize ROW assessment done during pre-project planning of this project?

☐ High level ☐ Medium level

☐ Low level

2.5.5 How many different sub-contractors / consultants were involved in designing this project?

____
(Total number of sub-contractors / consultants)

2.5.6 How many sub-contractors were involved in constructing this project?

____

(Total number of sub-contractors)

2.5.7 Were different entities of the project (e.g., owner, contractor, program manager etc.) co-located in close proximity?

☐ Yes ☐ No

2.5.8 Was there a formal documented change management process used to address design and / or construction changes on this project?

☐ Yes ☐ No

2.5.9 Was formal Value Engineering used on this highway project? If yes, how much project cost was saved?

☐ Yes ______________________________________(US $)

☐ None

2.5.10 Was one or more constructability reviews carried out during the design phase of this project?

☐ Yes ☐ No

2.5.11 Please describe any unique approaches to Traffic Control Planning?

____

____

____

☐ None

2.6 *Work Processes*

2.6.1 Please describe any new technologies being used to construct the project?

____

____

☐ None

2.6.2 Please describe any special information-sharing software used to transfer information between various project entities. (beyond email)

____

____

☐ None

2.7 *Project Calendar*

2.7.1 Please fill the start and end dates (month / year) of different phases of this project.

Project phases	**Date in months & years**	
Total project	/	/
Design	/	/
ROW acquisition	/	/
Utility adjustments	/	/
Construction	/	/

2.7.2 How many days (on average) did designers normally work in a given week on this project?

☐ 4 days a week ☐ 5 days a week
☐ 6 days a week ☐ 7 days a week

2.7.3 How many hours per day (on average) did designers normally work during the design of this project?

☐ 6 hours per day ☐ 7 hours per day
☐ 8 hours per day ☐ 9 hours per day
☐ 10 hours per day ☐ More than 10 hours

2.7.4 How many days (on average) did construction workers normally work per week?

☐ 4 days a week ☐ 5 days a week
☐ 6 days a week ☐ 7 days a week

2.7.5 How many hours per day (on average) did construction workers normally work on this project?

- ☐ 6 hours per day
- ☐ 7 hours per day
- ☐ 8 hours per day
- ☐ 9 hours per day
- ☐ 10 hours per day
- ☐ More than 10 hours

2.7.6 What was the estimated peak number of construction workers?

____

2.7.7 Please estimate the total construction work hours needed to complete this project?

____

2.7.8 How many shifts did construction workers work per day?

☐ One ☐ Two ☐ Three

2.7.9 Please describe any major delays that occurred in the construction of this project?

____

____

____

☐ None (Go to 2.7.12)

2.7.10 Approximately how many working days had been lost due to these major delays?

____

(Total number of work days)

2.7.11 Please briefly describe the severity of winter weather on this project.

____

____

____

2.7.12 How many winter seasons occurred during the construction phase of this project?

____

2.7.13 Approximately how many working days were lost due to winter or adverse weather?

____

(Total number of work days)

2.8 *Environmental Issue*

2.8.1 Please describe any unanticipated delays due to environmental issues?

____

____

2.8.2 Did this project involve any of the following:

Contaminated soil	☐ Yes	☐ No
Contaminated ground water	☐ Yes	☐ No
Endangered species	☐ Yes	☐ No
Historical sites/structures	☐ Yes	☐ No
Wet lands	☐ Yes	☐ No
Asbestos	☐ Yes	☐ No
Wildlife refugee	☐ Yes	☐ No
Archeological sites (incl. cemeteries)	☐ Yes	☐ No
Other environmental sensitive issues	☐ Yes	☐ No

2.9 *Right-of-Way*

2.9.1 Who was responsible for procurement of the right-of-way parcels for the construction of this project?

☐ Contractor ☐ Owner

☐ Other ____
(Name of entity)

2.9.2 How many total right-of-way parcels were procured for the construction of this project?

____
(Total number of parcels)

2.9.3 How many right-of-way parcels or what % were acquired through eminent domain / condemnation for this project?

____
(Total number of parcels or %)

☐ None

2.9.4 How many right-of-way parcels or what % were acquired through administrative settlement for this project?

____

(Total number of parcels or %)

☐ None

2.9.5 How would you characterize ROW delays (if any) on this project?

☐ Severe ☐ Moderate / Typical ☐ Insignificant

2.10 *Utility Adjustments*

2.10.1 Approximately how many utilities were adjusted for the construction of this project?

____

(Total number of utilities adjusted)

☐ None (Go to 2.10.3)

2.10.2 If any adjustments were delayed, approximately how many working days were lost as a result?

____

(Total number of working days lost)

2.10.3 Approximately how much was the Subsurface Utility Engineering (SUE) budget for this project?

____

(Total budget in US $)

☐ None

2.11 *Owner Staffing*

2.11.1 What is the total Full Time Equivalent (FTE) of Department of Transportation staff for this highway project?

____

(Total FTE)

2.11.2 Was a program manager used to supplement the Department of Transportation personnel?

☐ Yes ☐ No (Go to 3.1)

2.11.3 If yes, what was the FTE's for this project?

____

Section 3:

3 Project Performance:

3.1 *Project Cost Related Performance:*

Please provide the following cost related performance data of your project.

No.	**Cost related project performance**	**Cost (US $)**
1.	Owner estimated design and construction cost	
2.	Contractor's bid / negotiated amount	
3.	Contract amount	
4.	Total project completion cost	
5.	Owner estimated design cost	
6.	Final design cost	
7.	Final ROW cost	
8.	Final utility adjustment cost	
9.	Owner estimated construction cost	
10.	Final construction cost (including change orders)	

3.2 *Project Schedule Related Performance:*

Please provide the following schedule-related performance data of this project.

No.	**Schedule related project performance**	**Duration (Days or Months)**
1.	Owner estimated design and construction duration	
2.	Contractor's bid duration	
3.	Actual project completion duration	
4.	Owner estimated design duration	
5.	Final design duration	
6.	Owner estimated construction duration	

7.	Final construction duration	

3.3 *Project Construction Safety Related Performance:*

Please provide the following construction safety-related performance data of this project.

No.	Construction safety-related performance	
1.	Total number of fatalities	
2.	Total number of days away from work, restricted activity or transfer (DART)	
3.	Total number of work zone traffic accidents	

3.4 *Project Quality Related Performance:*

Please provide the following quality-related performance data of this project.

No.	Quality-related performance	
1.	Total number of Request for Information (RFI)	
2.	Total number of Non-Conformance Reports (NCR)	
NCR: NCR is a report submitted by the owner's verification team when the contractor does not meet the specification requirement.		

3.5 *Project Change Order- Related Performance:*

Please provide the following change order-related performance data of this project.

No.	Change order-related project performance	
1.	Total number of design change orders	
2.	Total cost of design change orders (US$)	
3.	Total number of construction change orders	
4.	Total cost of construction change orders (US$)	

3.6 *Project Claim- Related Performance:*

Please provide the following claims-related performance data of this project.

No.	Claims-related project performance	
1.	Total number of design claims	
2.	Total cost of design claims (US$)	
3.	Total number of construction claims	

4.	Total cost of construction claims (US$)	

Section 4:

4 Stakeholders' Success:

4.1 Who was the design-build contractor for this highway project? Please provide the following information.

Name of Contractor: ______________________________

Address: ______________________________

____

____

Website address (If any): ______________________________

Email Address: ______________________________

Phone Number: ______________________________

4.2 How would you rate the overall performance of this project compared to other design-build (DB) projects?

☐ Excellent ☐ Good

☐ Fair ☐ Poor