EVALUATION OF OREGON DEPARTMENT OF TRANSPORTATION PROJECT DELIVERY

Final Report

SPR 351

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by

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16. Abstract

This report summarizes analysis of Oregon Department of Transportation (ODOT) methods of insourced and outsourced project delivery using data obtained from ODOT reporting systems, ratings of project effectiveness by ODOT Area Managers and by construction contractors, and interviews with ODOT Area Managers and managers from engineering consulting firms that ODOT uses for outsourced design-bid-build projects. Results of a literature review and DOT survey were published in an interim report in December 2003. Guidelines, including a decision tree, are provided for assignment of projects for insourced design-bid-build, outsourced design-bid-build, or design-build delivery.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit	(F-32)/1.8	Celsius	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
m^2	meters squared	1.196	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
ml	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius	1.8C+32	Fahrenheit	°F

*SI is the symbol for the International System of Measurement

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EVALUATION OF OREGON DEPARTMENT OF TRANSPORTATION PROJECT DELIVERY

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ACEC	American Council of Engineering Companies
ADU	ODOT Alternative Delivery Unit
AM	ODOT Area Manager
ATA	agreement-to-agree
CE	construction engineering
CII	Construction Industry Institute
CPM	ODOT Consultant Project Manager
DB	design-build project delivery (also referred to as D/B)
DBB	design-bid-build project delivery (also referred to as D/B/B)
EA	expenditure account
GC	general contractor
GYR	“Green, Yellow, Red” report
HCP	ODOT Highway Construction Plan
IDBB	insourced-design-bid-build project delivery
LWCIR	Lost Work Case Incident Rate
ODBB	outsourced-design-bid-build project delivery
ODOT	Oregon Department of Transportation
OPD	ODOT Office of Project Delivery
OSHA	Occupational Safety & Health Administration
OSU	Oregon State University
OTC	Oregon Transportation Commission
OTIA	Oregon Transportation Investment Act (chronology of funding authorizations referred to as OTIA I, OTIA II, etc.)
PD	project delivery
PDLT	ODOT Project Delivery Leadership Team
PE	preliminary engineering
PL	ODOT Project Leader
PM	ODOT Project Manager
PS&E	plans, specifications, and estimates
RIR	Recordable Injury Rate
ROW	right-of-way
STIP	ODOT State Transportation Improvement Program
TAC	Technical Advisory Committee (for this study)
TSRM	ODOT Technical Services Region Manager
WOC	work order contract

EXECUTIVE SUMMARY

Oregon State University (OSU) and the Oregon Department of Transportation (ODOT) began an evaluation of outsourcing of design and construction project delivery in August 2002. The research objectives were to evaluate ODOT's project delivery methods, including variations in resource requirements. Guidelines for insourcing/outsourcing decisions were to be developed. Project delivery methods studied included traditional insourced-design-bid-build (IDBB), outsourced-design-bid-build (ODBB), and design-build (DB).

Information and data were collected through an extensive literature review, surveys of DOTs regarding their practices, interviews with ODOT Area Managers (AMs), interviews with the consulting engineering firms with which ODOT contracts for delivery of preliminary engineering (PE) and construction engineering (CE), an analysis of PE and CE costs, AM ratings of project performance, construction contractor ratings of project performance, and schedule, budget, cost, and change order data. Results from the literature review and survey of DOTs were presented in the Interim Report (Rogge, et al. 2003). This final report presents the findings from the remainder of the research activity.

Low numbers of outsourced projects with usable data made it very difficult to detect any statistically significant differences in means between performance measures for IDBB, ODBB, and DB projects. Consequently, heavy reliance was placed on findings from interviews with ODOT Area Managers and with ODOT's project delivery consulting firms.

For ODOT, when outsourcing of project delivery is necessary, projects with well-defined scope and aggressive schedules are highest priority for outsourcing. By project type for ODOT, bridge projects are normally the first choice for outsourcing, and preservation projects are usually the first choice for insourcing. A decision tree is provided to aid ODOT in making the insource or outsource decision on a project-by-project basis.

1.0 INTRODUCTION

1.1 BACKGROUND

In August 2002, Oregon State University (OSU) and the Oregon Department of Transportation (ODOT) began an evaluation of insourced and outsourced project delivery. Traditional insourced design-bid-build (IDBB) delivery, outsourced design-bid-build (ODBB) delivery, and outsourced design-build (DB) delivery were included in the study. An interim report was published in December 2003 (*Rogge, et al. 2003*). The interim report summarized the results of a comprehensive literature review and a survey of state Departments of Transportation (DOT). This final report summarizes data gathered regarding ODOT's experiences with insourcing and outsourcing of project delivery through September 2006.

The focus of this final report is on ODOT's experiences with IDBB and ODBB. This is because the number of ODOT projects outsourced through DB has been small, because DOT experiences with DB have been extensively documented (*Postma, et al. 2002; Prasad 2002; Rogge 2001; Sumner 2002*), and because the interim report dealt extensively with DB. This final report documents the use of numerous analyses of results from IDBB and ODBB projects to evaluate ODOT project delivery effectiveness, and it provides guidelines to ODOT for outsourcing project delivery.

Data were collected through statistical analyses of project information databases, interviews with ODOT Area Managers, interviews with the consulting engineers that ODOT uses for ODBB delivery, subjective ratings of database projects by ODOT Area Managers, and subjective ratings of construction contractors executing the construction phase of projects.

1.2 RESEARCH OBJECTIVES

The objectives of the research project were as follows:

1. Evaluate methods used to deliver the Oregon Transportation Investment Act (OTIA) and State Transportation Improvement Program (STIP) projects;

2. Assess resource requirements and implications of implementing different types of project delivery models; and

3. Develop guidelines for ODOT staff to make informed decisions on which delivery method is best suited for a particular project.

1.3 DEFINITIONS

Definitions for three important terms used in this report are as follows:

Project Delivery: The starting point for project delivery is the point in time when the project is approved for the Statewide Transportation Improvement Program (STIP), or, for OTIA projects, the time of project authorization. The ending point for project delivery is final acceptance by ODOT of the completed construction project. All project management, engineering, contract administration, construction oversight, and inspection activities required to take place during this time frame represent the project delivery function. Many DOTs use the terminology preliminary engineering (PE) and construction engineering (CE or CEI) to cover the functions traditionally executed by agency personnel during project delivery.

Insourcing: Insourcing is the practice of an agency using direct employees of the agency to provide services which are the responsibility of the agency.

Outsourcing: Outsourcing is the practice of an agency contracting with one or more entities (private businesses or other agencies) to provide services which are the responsibility of the agency.

1.4 ODOT'S MODEL FOR OUTSOURCING PROJECT DELIVERY

Figure 1.1 graphically portrays ODOT's model for insourced and outsourced project delivery. Sections 1.4.1 and 1.4.2 discuss these models.

It should be noted that even in the insourced model, ODOT frequently outsources specific packages of work to consultants. Specific studies or design activities may be outsourced in the design phase of a project. Construction surveying, formerly performed by ODOT, is now an assigned responsibility of construction contractors. Material testing, formerly done by ODOT, is a contract requirement for field testing of materials and is incidental to the bid item. What distinguishes the outsourced project delivery model is the assignment of overall accountability for project delivery to a single business entity outside of ODOT.

1.4.1 ODOT's insourced project delivery

ODOT has traditionally delivered projects according to the traditional insourced design-bid-build (IDBB) model described in Figure 1.1. Projects are designed using the Project Development Team, led by the "Project Leader" and consisting of ODOT employees augmented with flexible services consultant contracts as needed. At the completion of PS&E (Plans, Specifications, and Estimates), projects are advertised for bid. Contracts for construction are awarded to the lowest responsive bidders. During construction an ODOT "Project Manager" leads a construction engineering (CE) team responsible for assuring that both ODOT and the contractor fulfill the requirements of the contract. The construction contractor is accountable to the Project Manager.

Insourced

<u>Standard ODOT Insourced Design-Bid-Build (IDBB) project delivery model</u>

- Single relationship between the owner (ODOT) and the contractor
- Project design utilizes the ODOT Project Development Team
- Utilizes ODOT staff or augmented with flexible services consultant contracts
- Traditionally is the predominant model for project delivery at ODOT

Outsourced

<u>Outsourced Design-Build (DB)</u>

- Variation of the traditional DBB where the owner (ODOT) establishes a relationship with supplier (design-build contractor) to deliver an entire project or program.
- Supplier has internal management and technical capability to deliver the entire project or program.
- Supplier (design-build contractor) <u>accepts</u> construction risk.
- ODOT has limited experience in outsourced DB beginning in 1999.

<u>Outsourced Design-Bid-Build (ODBB)</u>

- Similar to ODOT Insourced DBB except the owner (ODOT) establishes a relationship with supplier (consulting engineer) to deliver an entire project or program.
- Supplier has internal management and technical capability to deliver the entire project or program.
- Supplier (consulting engineer) <u>does not accept</u> construction risk.
- Supplier designs project; ODOT selects contractor; supplier manages contractor.
- ODOT had <u>no</u> experience with this type of project delivery model prior to 2002.

Figure 1.1: ODOT models for project delivery (*Wolfe 2002*)

1.4.2 ODOT's outsourced project delivery

The authorization of the Oregon Transportation Investment Act (OTIA) funding in 2001 resulted in a need to deliver an increased project load without expanding the ODOT organization proportionally. ODOT had developed some knowledge of DB project delivery through research and implementation of two DB pilot projects beginning in 1998 (*Simas and Rogge 1998; Rogge 2001*). DB had proven to be a viable project delivery option, but it would not be feasible to use only DB to deliver the greatly increased project load. DB would be one of the methods used to deliver projects.

An evaluation by ODOT's Office of Project Delivery led to the formulation of an outsourced design-bid-build (ODBB) strategy. This strategy qualifies a pool of full-service consulting engineering companies. The consultants are qualified to deliver preliminary engineering (PE) and construction engineering (CE) for projects. ODOT intends that the same consultant will deliver a project through PE and CE. (*State of Oregon 2002*) Thus, ODBB is similar to ODOT's traditional IDBB, except the owner (ODOT) establishes a relationship with a consulting firm to deliver an entire project or program. The consulting firm has internal management and the technical capability to deliver the entire project or program, but does not accept construction risk (assigned to construction contractor). The consulting firm designs the project; ODOT selects and contracts with the construction contractor; and the consultant manages the contractor. This approach is in agreement with the findings of the ODOT Consultant Strategy Committee (*ODOT Consultant Strategy Committee 2000*).

The consulting engineers enter into agreement-to-agree (ATA) contracts with ODOT (*State of Oregon 2002*). The ATA contracts are for six years, the last two years of which allow for completion of projects initiated in the first four years. After the consulting firm has entered into an ATA, projects are assigned with a work order contract (WOC). ODOT assigns projects to the ATA pool, with the "top ranked firm selecting first, and the remaining firms selecting in order of their evaluation ranking until all projects on the initial list are assigned (*State of Oregon 2002*)." All subsequent project assignments or "rounds" use a simple rotation, where the next available firm is assigned the next consecutive project.

As consulting firms deliver their projects, they earn performance evaluation scores ranging from -5 to +5. There are criteria established for evaluation at the completion of each key milestone in PE, and semiannually for CE. There is also an extensive end-of-project evaluation. Performance evaluation forms are included in the ATA as Exhibit E. Each consulting firm starts with a performance evaluation score of zero. As a performance incentive, firms that improve their performance evaluation score to a +5 are eligible for two projects when their turn in the rotation comes up. Firms falling to -5 are removed from the project rotation cycle. When a firm is removed from the rotation cycle they must submit a performance management plan to ODOT for review and approval. When approved, the firm is reinserted into the project rotation cycle at the bottom of the list for the current round.

WOCs for PE are written with lump sum values for key milestones, and progress payments are made based on the percent that a milestone is completed. A maximum of five key milestones is allowed. WOCs for CE are written on a time and materials/labor-hours basis, with progress payments based on hours billed and expenses incurred at approved rates. Both PE and CE WOCs are written with *not-to-exceed values*.

To manage the outsourced projects, ODOT created the position of Consultant Project Manager (CPM). The CPMs report to Area Managers in the ODOT administrative regions where they are assigned, similar to the way that ODOT Project Leaders and Project Managers report to Area Managers for insourced projects.

1.4.3 Assigning the project delivery method

ODOT has organizational capabilities to deliver a construction program resulting in construction contractor payments of approximately $250 million per year. This has been the approximate level of construction contract volume for ODOT for approximately the last ten years. The first two project funding rounds of the Oregon Transportation Investment Act (OTIA I and II) resulted in project loads much greater than $250 million per year; hence the need for outsourcing, and the utilization of the outsourced models shown in Figure 1.1.

The target for ODOT's Technical Services and Construction Section is to be staffed at a capacity to deliver a $250 million program with 70% permanent staffing and 30% flexible services contracts. Additional projects must be outsourced. The majority are delivered ODBB, with selected projects delivered DB.

The process for assigning a delivery method to projects is shown in Figure 1.2. Block A at the bottom of the diagram shows that projects that have progressed past design approval for insourced projects or past work order assignment for outsourced projects are to be finished with no change to the original resourcing decision. Projects that have not progressed to those points are to be assigned a project delivery method.

The criteria presented in Tables 1.1, 1.2, and 1.3 are to be used by ODOT Region Managers, Area Managers, Program Managers, Tech Services Region Managers, Alternative Delivery Unit, Project Leaders, Consultant Project Managers, and Project Managers for assigning projects to one of the three delivery methods. Block 1 of Figure 1.2 shows a screening using Table 1.1 to determine if design-build is a good option. If so, the project is recommended to ODOT's Project Delivery Leadership Team (PDLT) for approval. The PDLT must balance the recommendation against available capacity. The PDLT consists of six high-level ODOT managers and is co-chaired by the Deputy for Statewide Project Delivery and the Technical Services Manager. Projects that are not likely candidates for design-build delivery must be assigned either insourced DBB (see Block 2, Figure 1.2) or outsourced DBB (see Block 3, Figure 1.2), based on the criteria of Tables 1.2 and 1.3. If agreement cannot be reached, or if insourcing or outsourcing capacity would be exceeded, the decision is referred to the PDLT.

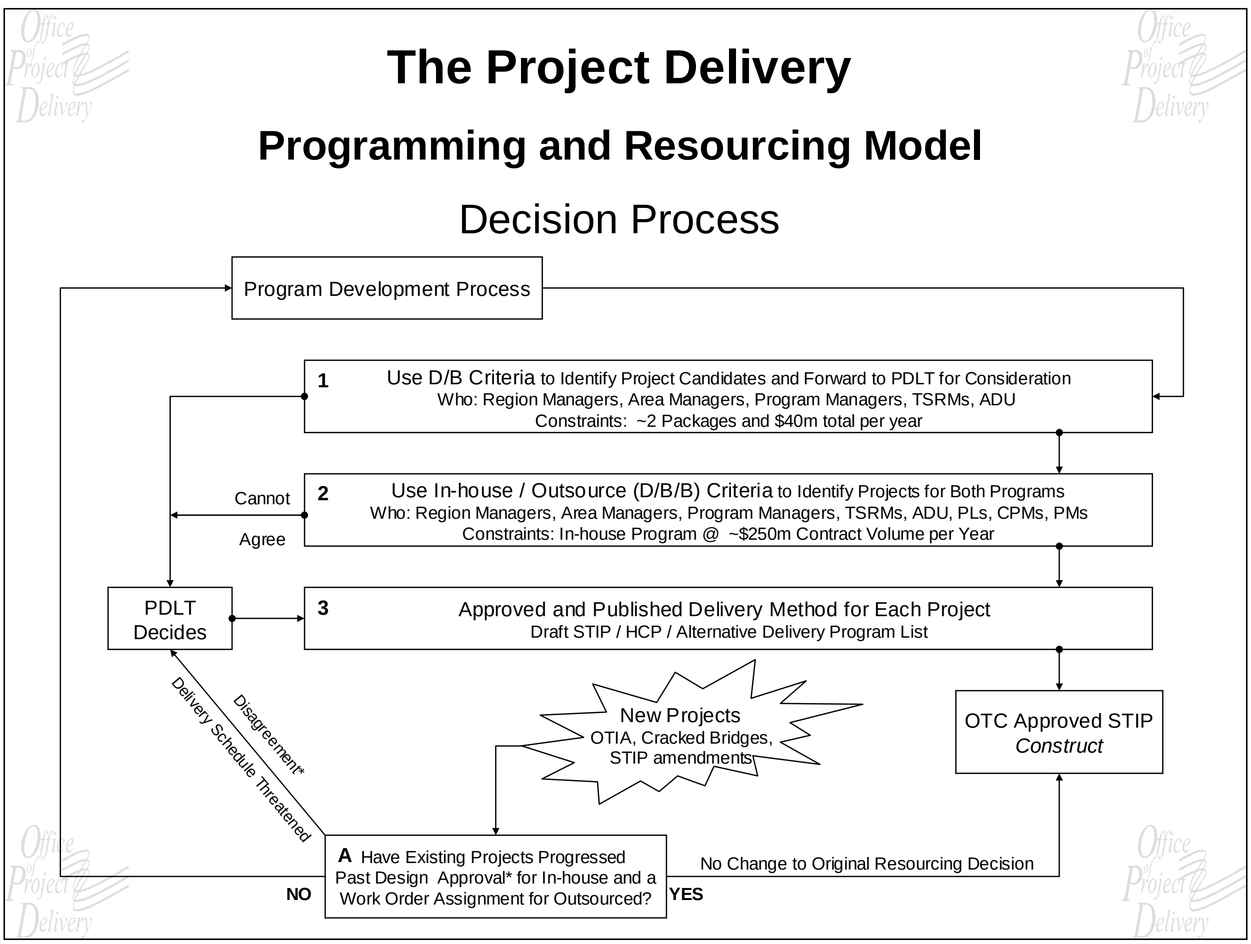


Figure 1.2: Process for assigning project delivery method (*Wolfe 2003*)

Table 1.1: Outsourced DB preferred (*Wolfe 2003*)

Selection Criteria – Outsourced DB
Need for innovation, alternatives, or economies of scale.
Use of innovative construction methods to meet performance criteria.
Clearly definable and transferable risk elements.
Minimizes user costs.
Expedited delivery requirements.
Committed funding strategy for the project.
Consultant Project Manager and D/B program capacity available.
Desire to build D/B experience with various project work types.

Table 1.2: Insourced DBB preferred (*Wolfe 2003*)

Selection Criteria – Insourced DBB
Extremely complex in high-risk areas or tasks.
Maintains critical skill sets in project development and construction.
Construction capacity is available.
Scope is not locked down – public is not committed to project.
Financing is unstable or uncommitted.

Table 1.3: Outsourced DBB preferred (*Wolfe 2003*)

Selection Criteria – Outsourced DBB
Clearly definable project elements/tasks.
Concise project documentation – prospectus, purpose, and need.
Expedited delivery requirements.
Minimal management or delivery risks.
Financing is committed.
Capacity available in statewide ATA or separate RFP to meet the delivery timeline.
Consultant Project Manager capacity is available.

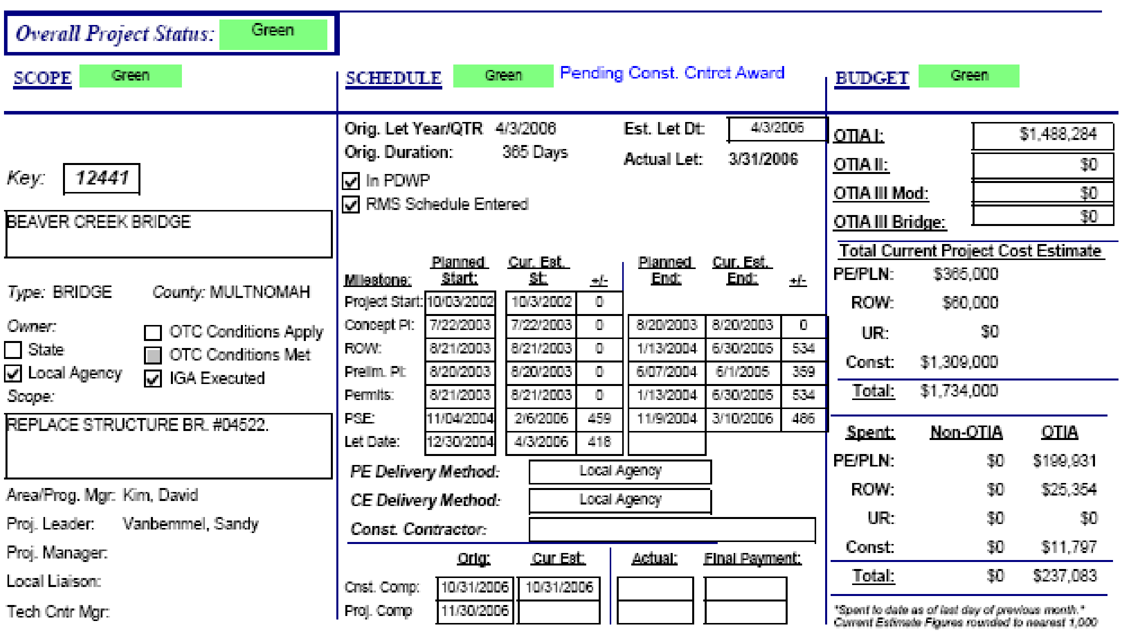
1.5 ORGANIZATION OF THE REPORT

Chapter 2 describes the research methodology employed to achieve the objectives for the research project. The various forms of data gathering and analysis, challenges faced, and limitations of the data are discussed. Chapter 3 summarizes the statistical analyses of objective and subjective data from the projects in the various databases. Chapter 4 and Chapter 5 document common threads from the Area Manager and project delivery consultant interviews. The progression through these chapters is in order from the most objective data to the most subjective data. Chapter 6 provides a summary, states conclusions, and makes recommendations, including guidelines for insourcing and outsourcing of projects. References may be located from the information presented in Chapter 7. The appendices provide raw data summaries and details of analyses and interviews.

2.0 RESEARCH METHODOLOGY

2.1 INITIAL STRATEGY

The OSU research team, with the concurrence of ODOT's Technical Advisory Committee (TAC) for the project, concluded that a database consisting of all of the OTIA I and II non-local-agency projects delivered in the year 2001 and thereafter would provide the best data for comparison of IDBB, ODBB, and DB projects delivered by ODOT. These projects would be operating under similar schedule and budget pressures, and would enjoy data collection and reporting procedures that were required by the legislation authorizing OTIA I and II. Indeed, a new "Green, Yellow, Red" report was created by ODOT's Office of Project Delivery (OPD) specifically to report on these projects. Figure 2.1 provides an example of this report.



Overall Project Status: Green

SCOPE Green

Key: 12441

BEAVER CREEK BRIDGE

Type: BRIDGE County: MULTNOMAH

Owner:
☐ State
☑ Local Agency

☐ OTC Conditions Apply
☐ OTC Conditions Met
☑ IGA Executed

Scope:
REPLACE STRUCTURE BR. #04522.

Area/Prog. Mgr: Kim, David
Proj. Leader: Vanbemmel, Sandy
Proj. Manager:
Local Liaison:
Tech Cntr Mgr:

SCHEDULE Green Pending Const. Cntrct Award

Orig. Let Year/QTR 4/3/2006 Est. Let Dt: 4/3/2006
Orig. Duration: 365 Days Actual Let: 3/31/2006
☑ In PDWP
☑ RMS Schedule Entered

Milestone:	Planned Start:	Cur. Est. St:	+/-	Planned End:	Cur. Est. End:	+/-
Project Start:	10/03/2002	10/3/2002	0			
Concept Pl:	7/22/2003	7/22/2003	0	8/20/2003	8/20/2003	0
ROW:	8/21/2003	8/21/2003	0	1/13/2004	6/30/2005	534
Prelim. Pl:	8/20/2003	8/20/2003	0	6/07/2004	6/1/2005	359
Permits:	8/21/2003	8/21/2003	0	1/13/2004	6/30/2005	534
PSE:	11/04/2004	2/6/2006	459	11/9/2004	3/10/2006	486
Let Date:	12/30/2004	4/3/2006	418			

PE Delivery Method: Local Agency
CE Delivery Method: Local Agency
Const. Contractor:

	Orig:	Cur Est:	Actual:	Final Payment:
Cnst. Comp:	10/31/2006	10/31/2006		
Proj. Comp	11/30/2006			

BUDGET Green

OTIA I:	$1,488,284
OTIA II:	$0
OTIA III Mod:	$0
OTIA III Bridge:	$0

Total Current Project Cost Estimate

PE/PLN:	$365,000
ROW:	$60,000
UR:	$0
Const:	$1,309,000
Total:	$1,734,000

Spent:	Non-OTIA	OTIA
PE/PLN:	$0	$199,931
ROW:	$0	$25,354
UR:	$0	$0
Const:	$0	$11,797
Total:	$0	$237,083

Spent to date as of last day of previous month.
Current Estimate Figures rounded to nearest 1,000

Figure 2.1: Sample Green-Yellow-Red report

It was estimated that this database would consist of about 80 projects. It was recognized that the number of DB projects would be small, but because of ODOT's limited experience with DB, no choice of database was going to produce numbers large enough to make statistical inferences about DB project delivery. The data were to be provided to the research team by the ODOT OPD, the same organization responsible for production of the "Green, Yellow, Red" reports.

To develop guidelines for ODOT to use to assign projects to IDBB, ODBB, or DB delivery, the OSU research team determined that it would be helpful to answer the research question, **"Is there a statistically significant difference in project performance with respect to budget, schedule, and overall end result between the three methods of project delivery when preservation projects are compared, when bridge projects are compared, and when modernization projects are compared?"** To attempt to answer this question, performance measures for these criteria were collected for each project in the database. In reality, the numbers of DB projects were so small that no comparisons with DB delivery could be made. Comparisons were made between IDBB and ODBB projects.

Section 3.6 of the Interim Report (*Rogge, et al. 2003*) reported on various performance measures for project delivery. The most comprehensive set of performance measures for project delivery was that used by the Benchmarking and Metrics Committee of the Construction Industry Institute (*Thomas 1998*). The Construction Industry Institute (CII) is a research organization whose membership includes Fortune 500 companies, large government agencies, and the design and construction firms that deliver capital projects for them. Since the late 1990's, CII has conducted a benchmarking service for member companies. The 1997 summary prepared by the CII Benchmarking and Metrics Committee includes a description of project delivery metrics used. An adaptation of a CII table (*Thomas 1998*) is reproduced here as Table 2.1.

Table 2.1: CII metrics framework

Category	Overall Project	Pre-Project Planning	Design	Bid & Award	Construction
Safety, Health & Environment					OSHA Safety • RIR • LWCIR
Schedule	• Schedule Factor • Schedule Growth • Actual Project Duration	• PPP Duration Factor	• Design Duration Factor	• Bid & Award Duration Factor	• Construction Duration Factor • Construction Phase Duration
Cost	• Budget Factor • Cost Growth	• PPP Cost Factor	• Design Cost Factor • Cost Growth	• Bid &Award Cost Factor • Cost Growth	• Construction Cost Factor • Cost Growth
Changes	• Change Cost Factor				
Quality					Total Field Rework Factor

Table 2.1 was chosen as the starting point for discussing metrics for project performance. During February through May of 2004, a series of meetings was held, including two TAC

meetings, to structure the compilation of data for this research project. Although it was considered desirable to include performance measurements for safety, health & environment and for quality, discussion with the TAC led to the conclusion that collection of meaningful data for these criteria would not be possible, either because of the time frame of the research project, or because the information was not collected on a routine basis. Consequently, data collection targeted cost and schedule metrics only. For the ODOT data collection procedures, obtaining data for the measures of Table 2.2 became the goal for the research project. These metrics are defined in Table 2.3. Data were supplied by ODOT's Office of Project Delivery.

Table 2.2: CII Metrics adjusted for the ODOT research project restraints

Category	Overall Project	Design	Construction
Safety, Health & Environment			
Schedule	• Schedule Growth		
Cost	• Cost Growth	• Cost Growth	• Cost Growth
Changes			• Dollars of change orders divided by original construction contract amount expressed as percent
Quality			• Days from 2nd to 3rd Notice (CE Performance)

The "new" measure introduced for the ODOT study was, "Days from 2nd Notice to 3rd Notice." This measure was introduced because it was the experience of TAC members with contract administration (i.e. CE) experience that the time required to move from 2nd to 3rd notice for a project is a good indicator of the quality of construction contract administration – faster is better. Consequently this metric was introduced as a measure of contract administration effectiveness. ODOT's definitions of 2nd and 3rd Notice are presented in the next paragraphs.

ODOT Standard Specification Section 00180.50(g), End of Contract Time (http://www.oregon.gov/ODOT/HWY/SPECS/2002_std_specs.shtml), states, "When the Engineer determines that the Work has been completed, except for the items listed below, the Engineer will issue a Second Notification.

- The date the time charges stopped;
- Final trimming and cleanup tasks (See 00140.90);
- Equipment to be removed from the Project Site;
- Minor corrective work not involving additional payment to be completed; and
- Submittals, including without limitation all required certifications, bills, forms, warranties, certificate of insurance coverage (00170.70(e)), and other documents, required to be provided to the Engineer before Third Notification will issue."

Table 2.3: Performance metric definitions

Measure	Definition	Formula
BUDGET		
Design Budget Growth	At time of construction bid award divide actual PE expended by the original STIP approved PE budget.	PE Expended --------------------- PE Budgeted
Construction Budget Growth	At conclusion of the project, compare actual construction expenditures to original construction contract award amount.	Actual Construction Expended --- Original Construction Contract Award Amount
Total Project Budget Growth	At conclusion of the project, divide total project expenditures by the total project allocation, which includes original approved STIP preliminary engineering, right of way, construction and utility costs.	Total Project Expenditures ---------------------------------- Total Project Allocation
SCHEDULE		
Design Schedule Growth	Compute the difference in days between original approved bid let and actual bid let. Divide this quantity by the original target duration from project start to approved bid let date.	(Actual Bid Let – Approved Bid Let) -- (Approved Bid Let – EA Date)
Construction Schedule Growth	Compute the difference in days between the contract specified construction completion date and the actual construction completion date (2nd note). Divide by original target duration.	(Actual 2nd Notice – Actual Bid Let) -- (Specified Construction Complete – Actual Bid Let)
Total Project Schedule Growth	Add the design schedule growth in days to the construction schedule growth in days. Divide this quantity by the difference between Approved Bid Let and Start plus the difference between Specified Construction Complete and Actual Bid Let.	(Actual 2nd Notice – EA date) -- (Specified Construction Complete – Actual Bid Let) + (Approved Bid Let – EA date)
OTHER		
Days from 2nd Notice to 3rd Notice.	Compute the difference in days between the date of 2nd Notice and the date of 3rd Notice.	3rd Notice date – 2nd Notice date

Third Notice is defined as "Written acknowledgment by the Engineer, subject to Final Acceptance, that as of the date of the notification the Contractor has completed the Project in accordance with the Contract, including without limitation completion of all minor corrective work, equipment and plant removal, site clean-up, and submittal of all certifications, bills, forms and documents required under the Contract."

Speedy movement from 2nd to 3rd Notice can be an indicator that construction contract administration has dealt with all issues in a timely and thorough manner, allowing the rapid wrap-up of the project. Thus, the time between 2nd and 3rd Notice for a project was chosen to be a performance measure for CE.

2.2 PROBLEMS WITH THE INTENDED METHODOLOGY

When the OTIA I & II non-local-agency database supplied by ODOT's Office of Project Delivery (OPD) was examined, the value of the database came into question. While there were over 70 projects, many project start and end dates were missing.

During the investigation of the database, issues regarding project start dates arose. It was impossible to find agreement on the TAC regarding when projects started. Although the time that projects were given an EA (expenditure authorization) was suggested as a logical project start, this was not considered valid by some TAC members, because it is not uncommon for nothing to happen on a project for up to a year after establishment of an EA. Instead, the TAC believed that the time at which 2% of authorized funds were expended (arbitrarily chosen as a small percentage, but yet indicative that work was commencing) should define the starting point. In practice, however, determining the 2% date was not practical because of the databases with which OPD was working. The principal investigator thus chose the establishment of EA date as the start, based on the fact that activity could have started on that date for each project.

To add to the confusion, the end dates and budget data were not provided for some projects, because they had been split into multiple projects and/or combined into other projects to provide administrative efficiencies. In fact, several projects were split and combined more than three times. Tracking project performance through splits and combines would have been nearly impossible, and even if possible, it would have cast doubt on the validity of the end result.

In retrospect, the research team's goal of applying CII schedule metrics in the ODOT environment may have been too ambitious. ODOT's traditional control philosophy is that if the actual let date takes place in the targeted calendar quarter for the let date, the project is considered to have met schedule objectives. Therefore this is the way ODOT routinely collects data.

Fearing that the database could not be used at all due to lack of consistency and missing values, the OSU research team approached the TAC. After some discussion the database of OTIA I and II non-local-agency projects was supplemented with STIP projects. The expanded database included 561 projects. Projects with missing values and projects that were split and combined were removed from the database resulting in approximately 200 projects for analysis.

2.3 CHANGES IN METHODOLOGY

Because only 28 outsourced projects were part of the expanded database, other approaches to data gathering beyond the database analysis were necessary to meet the objectives of the research project. The use of case studies to gather additional perspective was considered. Examples of strong and weak performing IDBB, ODBB, and DB projects could be identified, followed by in-depth interviews of key personnel on the projects. However, review with the TAC resulted in abandoning the case study approach.

The TAC believed that more value would be obtained from other research activities. Interviewing ODOT Area Managers (AMs) and the consulting engineering consulting firms that ODOT uses to deliver ODBB projects were activities given highest priority. Also, the construction contractors with experience with ODOT projects delivered ODBB and IDBB would be asked to rate performance of PE and CE delivered on those projects. In addition, the TAC made available to the research team change order information from projects in the database. The details of these data gathering techniques are discussed in Chapter 3 as an introduction to the analyses of the information obtained.

2.4 SUMMARY DATABASE

The research team's goal was to create one large database with objective, quantitative, project data on the following factors: cost and schedule performance; area manager subjective ratings of cost, schedule, and quality; construction contractor ratings of quality of PE and CE; and change order information. Ideally, all of these measures would be available for all of the projects in the database. This was not possible, however. What was possible is shown in Appendix A, which lists by ODOT "key number" all projects from which some information was obtained. The spreadsheet of Appendix A contains 561 projects and includes the original OTIA I and II non-local agency projects and additional STIP projects required to produce a usable database. Projects that have been split and/or combined are also included. The column headings of the spreadsheet of Appendix A are now defined.

The key number is the identifying number that ODOT assigns to uniquely identify each project. Projects in the expanded database are identified in the expanded database column with an "X". The "Area Manager" column indicates the projects from which AM rating were obtained. The "OTIA I/II Data" column shows projects from the original database. The "PE/CE database" column indicates projects for which \$PE and \$CE data were available. The "contractor subj. data" column indicates the projects where contractors responded to requests for ratings of quality of design and contract administration.

2.5 DATA ANALYSIS METHODS

This summary is intended to provide the reader with an overview of the statistical methods utilized to draw conclusions and how to interpret the conclusions. Also presented is an explanation of the theory and assumptions that surround the statistical tests and the applicability of the data.

2.5.1 Two-sample comparisons

For this report the most common statistical test used is a two-sample comparison, as we are primarily interested in the difference in performance between insourced and outsourced project delivery for various performance metrics. There are two tests that may be performed for a two sample comparison: the two-sample t-test and the Wilcoxon rank sum procedure. Ideally, one would always opt for the two-sample t-test because it is significantly more precise than the Wilcoxon rank sum procedure. However, the following underlying assumptions of the data are required for the validity of the two-sample t-tests:

1. The populations are independent,
2. The data are from a normally distributed population, and
3. The standard deviation (i.e. the spread) of the populations is approximately equal.

The Wilcoxon rank sum procedure, on the other hand, is a distribution-free statistical test. That is, the data are not required to be from a normal population, nor do they have to have approximately equal standard deviations. One must note that the populations must always be independent (i.e., the value in one populations cannot be dependent upon one from another population) for any of the statistical methods (*Ramsey and Schafer 2002*).

The first step in any of the comparisons was to evaluate the assumptions of the two-sample t-test, as this was the test of choice for a two-sample comparison because of its precision. To test the validity of the assumptions, the best observational tool is the box plot. Box plots allow the observer to graphically evaluate the spread of the sample and the approximate distribution.

When conducting a statistical comparison, the first activity was to create a box plot (Figure 2.2) and evaluate the image. If the data appeared to be normally distributed (i.e., the box plot appeared to be roughly symmetrical), and the data appeared to have approximately equal standard deviations (i.e. both samples appeared to have the same spread), the two-sample t-test was conducted. If either of these assumptions was violated, the Wilcoxon rank sum procedure, a robust but less-precise statistical test, was used.

Reading a box plot can be troublesome to the layperson as it is very abstract without proper description. Figure 2.2 shows the anatomy of the typical box plot. One should note that many of the analyses performed in this report involve discrete values from a Likert scale and result in a box plot that is significantly different in appearance from that shown in Figure 2.2. For example, one might not see a maximum value if there are many ratings of ‘5’. Likewise, if there are few data points the data may not produce an interquartile range (25th percentile to 75th percentile, the body of the box plot). Instead, one will see a series of lines and dots. One must understand the way a box plot is constructed and be familiar with the data in order to appropriately interpret the image.

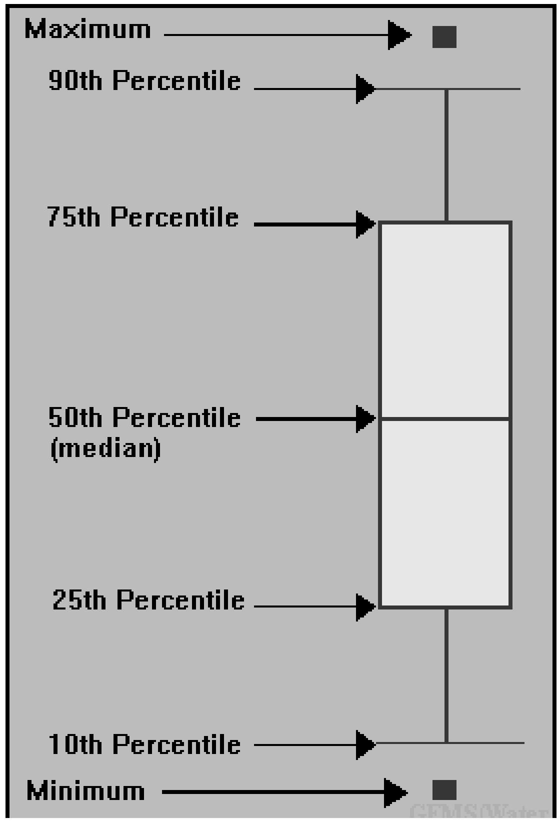


Figure 2.2: Typical box plot

2.5.2 Multiple comparison procedures

In some cases, such as the complexity survey, more than two samples must be compared to see if one sample is significantly different. Multiple sample comparisons are typically performed using the analysis of variance, otherwise known as the ANOVA procedure. Like the two sample t-test, the samples must be independent, normal, and have approximately equal standard deviations. The alternate test to ANOVA is the Kruskall-Wallace rank sum procedure. The Kruskall-Wallace rank sum procedure can be used to compare multiple samples when the samples have significant departures from normality. By replacing each value with its rank among the general population, differences in samples can be obtained. This test is especially proficient in analyzing samples that have significant outliers.

2.5.3 Interpreting results

All of the statistical tests used in this study ultimately produce a p-value. The p-value indicates the significance of the statistical results and provides statistical evidence of a difference in sample means. One must note that statistical significance indicates that the results would be difficult to attribute to chance alone.

The p-value represents the probability that, by random chance, one could obtain a difference in sample means that is as extreme as or more extreme than the observed differences of means. For example, a p-value of 0.01 indicates that there is a 1 percent chance that the difference in the sample means could exist by random occurrence. While the p-value is an objective and distinct value, the interpretation of the p-value can be subjective in nature. In lab experiments the typical threshold for the p-value is 0.05. In observational, social studies the interpretation is a bit looser. This is especially true for small samples with potentially high amounts of confounding variables, such as this study. Table 2.4 represents the interpretation of the p-value for this study.

Table 2.4: P-value interpretations used

P-value	Interpretation
P-value< 0.05	Extreme evidence
0.05<=P-value<0.10	Very strong evidence
0.10<=P-value<0.15	Strong evidence
0.15<=P-value<0.20	Moderate evidence
0.20<=P-value<0.25	Suggestive evidence
0.25<=P-value<0.30	Weak evidence
> 0.30	No statistical evidence

2.5.4 Use of statistical software

When performing analyses on the ODOT project delivery data the computer package S-PLUS was used. This statistical package performed every analysis mentioned. In each analysis the computer output is provided in the appendix. This output provided the raw outcome used to make statistical inferences about the samples.

2.5.5 Scope of inference

The data collected in this study must be considered observational. That is, there were no randomization techniques applied in the data sampling procedure. However, for those data samples that represent nearly the entire population, causal inferences can be made. Additionally, this sample was not obtained from a global population. Therefore, it would be inappropriate to extend inferences beyond the Oregon Department of Transportation or to any populations not represented by the sample.

2.5.6 Recap

Every two-sample statistical comparison involved the following procedure (multiple sample comparisons are performed in the same manner):

1. Data were organized into two distinct groups (e.g., insourced and outsourced).

2. Side-by-side box plots were created and analyzed.

3. If the samples indicated normal populations with equal standard deviations, the two sample t-test was performed.

4. If the samples did not appear to be normal, or if the samples did not have approximately the same standard deviations, the Wilcoxon rank sum procedure was performed.

5. The p-value was obtained from the statistical output and interpreted.

6. Conclusions were made.

Multiple sample comparisons were performed in the same manner.

3.0 DATA ANALYSES

Chapter 3 presents the results of analysis of each subset of the ODOT Project Database, following the procedures discussed in Chapter 2. Each discussion of analysis of each subset of the database begins with presentation of a summary table followed by discussion of the results. Appendix A contains the project data which was analyzed.

3.1 PRELIMINARY ENGINEERING (PE) AND CONSTRUCTION ENGINEERING (CE) COST DATABASE SUBSET

One of the research project objectives was to, "assess resource requirements and implications of implementing different types of project delivery models." ODOT routinely compiles values for % PE and % CE for all projects delivered. Percent PE reports the actual PE expenditures, divided by the total project cost (sum of PE and construction) at the time of contract awarding. Percent CE reports the CE expenditures, divided by the construction authorization amount, less CE expenditures (*ODOT 2003*).

It was possible to obtain PE and CE percentages for 224 of the projects in the Master Database. Information relating to the analyses of this subset of the database is summarized in Table 3.1. Appendix B displays the %PE and %CE values by project, sorted into bridge, modernization, and preservation projects.

Bridge projects: Although mean values of %PE and %CE for 3 ODBB bridge projects were lower than for 71 IDBB bridge projects (12.6% and 8.2% vs 13.8% and 11.9% respectively), the probabilities that these were random occurrences were too high for the differences in means to be considered statistically significant under the criteria chosen by the research team. No conclusions should be drawn.

Modernization projects: Analyses of modernization projects showed extreme statistical evidence that the mean value of 9.7% CE for 19 insourced modernization projects was lower than the mean value of 17.1% CE for 3 outsourced modernization projects. Comparisons of %PE for these projects showed that the higher mean value for ODBB projects is not statistically significant.

Preservation projects: The comparison of means of %PE values for insourced and outsourced preservation jobs showed weak statistical evidence that the mean value of 7.5% for 106 insourced projects was in fact less than the mean value of 9.2% for 6 outsourced projects. There was also moderate evidence that the mean value of 6.9% CE for IDBB projects was lower than the mean value of 9.4% CE for outsourced preservation projects.

The analyses of %PE and %CE indicate a preference for insourcing both PE and CE for preservation jobs. A preference for insourcing CE for modernization projects is also shown.

Table 3.1: Results of analysis of %PE and %CE database subset

Database Summary	
	n
Total Observations	**224**
ODBB Projects	**28**
IDBB Projects	**196**
Preservation Projects	**112**
Modernization Projects	**22**
Bridge Projects	**74**

Please note: %PE = Total dollars spent on PE services/Total Project Cost. %CE = Total dollars spent on CE services/(Construction Authorization - CE Expenditures)

		Insourced					Outsourced					Statistical Conclusions			
Parameter	Type	n	Min	Mean	Med	Max	n	Min	Mean	Med	Max	Diff. in Means	Favorable Delivery	p-value	Statistical Evidence
%PE	Bridge	71	0	13.8	12.2	39.8	3	5.1	12.6	9.5	23.2	1.1	Outsourced	0.891	None
%CE	Bridge	71	1.52	11.9	11.0	33.7	3	1.3	8.2	8.5	14.7	3.7	Outsourced	0.3956	None
%PE	Pres.	106	0.73	7.5	6.0	44.1	6	2.0	9.2	11.6	12.3	1.6	Insourced	0.2908	Weak
%CE	Pres.	106	0.65	6.9	6.1	17.3	6	4.4	9.4	11.4	12.9	2.6	Insourced	0.1609	Moderate
%PE	Modern	19	5.95	13.2	13.4	24.1	3	5.1	18.1	14.5	31.6	4.9	Insourced	0.5857	None
%CE	Modern	19	3.97	9.7	8.9	16.8	3	13.6	17.1	18.6	19.2	7.5	Insourced	0.0052	Extreme

P-value	Interpretation
< 0.05	Extreme evidence
0.05<=P-value<0.10	Very strong evidence
0.10<=P-value<0.15	Strong evidence
0.15<=P-value<0.20	Moderate evidence
0.20<=P-value<0.25	Suggestive evidence
0.25<=P-value<0.30	Weak evidence
> 0.30	No statistical evidence

Definitions
n: number of observations in a subset
p-value: the probability that, by random chance, one could obtain a difference in sample means that is as extreme as or more extreme than the observed.
Confidence Interval: the range of possible values for the difference in means represented by a confidence level
Statistical Evidence: Subjective interpretation of the P-value

The analysis above uses %PE and %CE from standard ODOT reporting procedures. As was noted in the interim report (*Rogge, et al. 2003*), it is possible that normal DOT reporting procedures do not adequately assess overhead charges to costs of DOT personnel. If ODOT reporting procedures underreport overhead costs for ODOT personnel the %PE and %CE values for insourced projects would be artificially low. Whether this is the case or not is frequently debated. For the purposes of this research, the research team could only use normally reported values.

But what about the quality of outsourced PE and CE compared to insourced PE and CE? To answer this question, the research team turned to the construction contractors tasked with building from the PS&E documents produced by PE, and executing the work in the CE environment.

3.2 ODOT CONSTRUCTION CONTRACTOR RATINGS OF PE AND CE SUCCESS

Construction contractors constructing the projects of the original non-local-agency OTIA I and II database were solicited for their evaluation of performance criteria related to the quality of PE and CE for each project. They were asked to provide subjective ratings of the ability of the projects' designs to allow them to be effectively and efficiently constructed, and of the quality of the construction contract administration and owner inspection. Criteria such as the completeness of the design, clarity of the design, etc. were added to the database to be included in the analysis. The form used is shown in Figure 3.1 and clearly shows the evaluations requested from the construction contractors.

It was not possible to obtain ratings for every project. Only 10 of 33 general contractors responded to the request to rate the projects that they had executed. One contractor, however, did volunteer ratings for 20 projects that were not in the non-local-agency OTIA I & II database subset. The research team decided to accept the volunteered information. Table 3.2 presents a summary of the analysis of the database of general contractor ratings. Appendix C contains the information used for the analyses.

The only type of projects which produced general contractor rating responses was the category of bridge projects. For bridge projects, outsourced projects were rated higher for six criteria, and ratings for insourced projects were higher for four criteria. Except for the "Administration" criterion (which is a CE rating), all parameters are associated with PE. Only ratings for two of these criteria showed meaningful statistical significance. These were "completeness of design presentation" and "constructability of design," which are both ratings of PE effectiveness, and which both favored outsourced delivery for bridge projects. Therefore, the quality ratings of general contractors do not contradict previously discussed preferences (based on %PE and %CE) for outsourcing PE and CE for bridge projects before outsourcing for preservation and modernization projects.

3.3 NON-LOCAL-AGENCY OTIA I & II DATABASE

The initial strategy for assembling a database of OTIA I & II projects and the rationale for that strategy were discussed in Section 2.1 of this report. Although the research team did not develop strong confidence in the quality of the data because of the frequency of splitting and combining projects after authorization for more convenient packaging of projects, and because the practice contributed to an atmosphere where there were frequent opportunities to get back on schedule by creating a new end date, the research team did analyze the data provided by ODOT's Office of Project Delivery (OPD).

The first database supplied by ODOT's OPD was received by the OSU research team in February of 2004. It contained 54 IDBB projects, 23 ODBB projects, and 4 DB projects, for a total of 81 projects. Updated databases were received from the ODOT OPD on a monthly basis. When it was observed that the projects were not the same from month to month, the challenges presented by splits and combines of projects became apparent. There were also inconsistencies between the database and information in the Green-Yellow-Red reports.

To whom it may concern, Our research team requests your subjective ratings of designer performance for several of the projects that your firm has recently been involved in. Please note, a score of 1 represents very poor performance, a score of 3 represents average performance and a score of 5 represents exceptional performance. Please place an 'x' in the cell corresponding to your score for each of the criteria. For clarity, several definitions of the criteria are provided below. If you have any questions please contact us at hallowem@onid.orst.edu. Tha you for your participation in this study.

Ltm, Incorporated

Key #	Work Type	Project Name	Reg	Bid Type	Estimated or Actual Let date	Completeness					Constructibility					Ability to Promote Productivity					Quality of Administration					Ability to Construct Safely					Timely response to RFI's					Ease of ROW					Ease of Permitting					Ease of utility work					Completeness of site survey				
						1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
09534	PRESRV	HATFIELD HWY JCT. - CALIFORNIA STATE LINE	4	DBB	5/22/2003																																																		
10876	MODERN	US101: ISTHMUS STREET - CEMETERY ROAD	3	DBB	5/22/2003																																																		
12731	MODERN	OR42: LOOKINGGLASS CREEK TO GLENHART (WINSTON)	3	DBB	1/26/2006																																																		
12732	MODERN	US101: 13TH ST - SEABIRD DRIVE (BANDON)	3	DBB	5/25/2006																																																		
13149	PRESRV	OR99: CHARLOTTE ANN DR -COLVER RD(MEDFORD-PHOENIX)	3	DBB	2/26/2004																																																		
12743	PRESRV	OR66: SISKIYOU BLVD TO SOUTH CITY LIMITS (ASHLAND)	3	DBB	5/27/2004																																																		
12385	PRESRV	OR234: DOWNTOWN GOLD HILL PAVING	3	DBB	2/26/2004																																																		
12386	PRESRV	COQUILLE MYRTLE GROVE STATE PARK-WHITE BR (POWERS)	3	DBB	4/25/2002																																																		
12413	PRESRV	WASHBURN WAY - US 97	4	DBB	5/12/2005																																																		

Definitions:

Completeness: completeness of design (i.e. minimization of scope changes)
Constructibility: constructability of design (i.e. minimization of change orders)
Ability to Promote Productivity: ability of design to promote productivity (well-coordinated design, constructor-friendly design documentation)
Quality of Administration: quality of administration of the construction contract on this project
Ability to Construct Safely: Ability of the design to facilitate construction safety
Timely Response to RFIs: Ability to communicate efficiently with designer to obtain information
Ease of ROW: Ability of design to avoid right-of-way (ROW) issues in construction
Ease of Permitting: Ability of design to avoid permitting issues during construction
Ease of Utility Work: Ability of design to avoid utility issues during construction
Completeness of Site Survey: Completeness of the survey performed during the design phase

Figure 3.1: Form used by construction contractors to rate quality of PE and CE of database projects

Table 3.2: Results of analysis of construction contractor ratings database subset

Database Summary	n
Total Observations	**30**
ODBB Projects	**8**
IDBB Projects	**22**
Perservation Projects	**10**
Modernization Projects	**9**
Bridge Projects	**12**

Please note: Data was collected using the Likert scale, where 1 = very poor performance and 5 = exceptional performance

		Insourced					**Outsourced**					**Statistical Conclusions**			
Parameter	Type	n	Min	Mean	Med	Max	n	Min	Mean	Med	Max	Diff. in Means	Favorable Delivery	p-value	Statistical Evidence
All	Modern							NA, n=0				no statistical comparison could be made			
All	Preserv							NA, n=0				no statistical comparison could be made			
Completeness	Bridge	5	1	3	4	5	7	2	3.9	4	5	0.9	Outsource	0.226	Suggestive
Constructability	Bridge	5	1	2.6	4	5	7	2	4.0	4	5	1.4	Outsource	0.274	Weak
Productivity	Bridge	5	1	2.8	4	5	7	2	3.8	4	5	1.0	Outsource	0.53	None
Admin	Bridge	5	3	3	4	4	7	1	3.6	3	5	0.6	Insource	0.36	None
Safety	Bridge	5	3	3.6	4	4	7	3	3.9	4	4	0.3	Outsource	0.3881	None
RFIs	Bridge	5	1	3	4	4	7	1	3.3	4	5	0.3	Outsource	0.7335	None
ROW	Bridge	5	2	3	3	4	7	2	3.0	3	4	0.0	Insource	1	None
Permitting	Bridge	5	3	3.2	3	4	7	2	2.9	3	4	0.3	Insource	0.3829	None
Utility	Bridge	5	1	2.8	3		7	2	2.9	3	3	0.1	Outsource	0.6889	None
Site Survey	Bridge	5	1	2.8	3	3	7	2	2.7	3	3	0.1	Insource	1	None

P-value	Interpretation
< 0.05	Extreme evidence
0.05<=P-value<0.10	Very strong evidence
0.10<=P-value<0.15	Strong evidence
0.15<=P-value<0.20	Moderate evidence
0.20<=P-value<0.25	Suggestive evidence
0.25<=P-value<0.30	Weak evidence
> 0.30	No statistical evidence

Definitions
n: number of observations in a subset
p-value: the probability that, by random chance, one could obtain a difference in sample means that is as extreme as or more extreme than the observed.
Confidence Interval: the range of possible values for the difference in means represented by a confidence level
Statistical Evidence: Subjective interpretation of the P-value

3.3.1 Project complexity

Early in the research it was determined that comparison of insourced and outsourced performance should include a recognition of any differences that might exist in the complexity of projects assigned for outsourcing and for insourcing. If projects being assigned to one type of project delivery were inherently simpler than projects being assigned to the other, achieving the same performance would be easier for the form of delivery with simpler projects. To deal with differences in project complexity, the research team decided to obtain ratings of complexity for each of the projects in the original database.

Considerable discussion between ODOT's Technical Advisory Committee (TAC) for the research project and the research team resulted in the decision to rate project complexity by use of a one-page rating sheet to be completed by ODOT's Area Managers (AM's). As previously mentioned, in the ODOT organization for project delivery, AM's are the lowest level of ODOT management present on both insourced and outsourced projects.

For insourced projects, Project Leaders report to Area Managers for preliminary engineering (PE), and Project Managers report to AM's for construction engineering (CE). For outsourced projects, Consultant Project Managers (CPM's) are ODOT employees reporting to AM's for both PE and CE on their outsourced projects.

Figure 3.2 shows a reproduction of one of the forms used to collect complexity ratings from the ODOT AM's.

At the time the complexity ratings were obtained, the non-local-agency OTIA I and II database contained 75 projects. This was the December 2004 database update. Attempts to obtain complexity ratings were successful for 61 (81%) of these projects. A 100% response rate was desired, but since multiple follow-ups did not produce more results, it was concluded that this was the best that was going to be obtained, and that it adequately represented the distribution of complexity between insourced and outsourced projects in the non-local-agency OTIA I and II database.

As additional project data became available in other database subsets, consideration was given to obtaining complexity ratings for those projects as well. The decision was made, however, to concentrate on using the limited time of the ODOT Area Managers to obtain information that was more critical to the overall objectives of the research. The complexity ratings obtained from the projects in the December 2004 non-local-agency OTIA I & II database are considered representative of the results of the process that ODOT uses for assigning projects for insourced or outsourced project delivery.

ATTN: Art Anderson

ODOT and OSU are conducting a study of project delivery of OTIA I and II projects through insourced design-bid-build, outsourced design-bid-build, and design-build, and of OTIA III bridge project delivery by program management. To objectively perform this study, it is important to have a measure of the relative complexity of each project in the database. You should receive a separate rating sheet for each OTIA I & II non-local-agency project in your jurisdiction. In the table at the bottom of each sheet, please provide a rating in each of the three following categories, as well as an overall rating.

Public Factors: Contentious ROW acquisition, access management, permitting requirements, political issues, public opinion and involvement, special inspections, etc.

Engineering & Design Factors: New, geometrically challenging, or unusual design; inadequate budget; utility conflicts, railroad conflicts, traffic, environmental issues, geotechnical challenges, etc.

Construction Factors: Traffic and Staging, safety, work-hour limitations, in water or underwater work, new technology/methods, space, access limitation, etc.

Thank you very much for your assistance in this endeavor.

Project Name:	***OR99: Charlotte Ann Dr – Colver Rd (Medford-Phoenix) Preservation***
Project I.D.:	*13149*
Area Manager's Name:	*Art Anderson*

Please mark the box corresponding with your evaluation of the complexity of this project relative to other ODOT projects. As a baseline, if you choose normal complexity, about half of ODOT projects (of all types – bridge, overlay – etc.) would be more complex, and about half would be less complex.	Very Simple	Simple	Normal Complexity (not unusually simple or complex)	Complex	Very Complex	Unable to Rate
PUBLIC factor complexity						[ ]
ENGINEERING and DESIGN complexity						[ ]
CONSTRUCTION complexity						[ ]
OVERALL complexity						[ ]

Comments: ______________________________

____

____

If unable to rate this project on some of the factors, please indicate why: ________

____

____

PLEASE RETURN THIS FORM TO (e-mail preferred):

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541.737.3300 (Fax)

Figure 3.2: Complexity rating form

Table 3.3 shows the summary of the statistical analysis of the complexity ratings made by ODOT's AM's for the non-local-agency OTIA I and II projects. Appendix D contains the information used for these analyses. For overall complexity of projects, strong statistical evidence suggests that modernization projects assigned IDBB are more complex than those ODBB, and very strong statistical evidence indicates that bridge projects assigned for IDBB delivery are less complex than those delivered ODBB. For preservation projects, there is no statistical evidence of a difference in complexity between IDBB and ODBB projects. There were insufficient DB projects in this database subset to include in a comparison.

Table 3.3: Summary of analysis of complexity of IDBB and ODBB projects

Database Summary	
	n
Total Observations	**61**
ODBB Projects	**18**
IDBB Projects	**43**
Preservation Projects	**32**
Modernization Projects	**22**
Bridge Projects	**7**

Please note: Data was collected using a Likert scale, where 1 = very simple and 5 = very complex

		Insourced					Outsourced					Statistical Conclusions			
Complexity Parameter	Type	n	Min	Mean	Med	Max	n	Min	Mean	Med	Max	Diff. in Means	Greater Complexity?	p-value	Statistical Evidence
Public	Preserv	25	1	2.9	3	5	7	1	2.7	3	4	0.2	Insourced	0.655	None
E&D	Preserv	25	1	2.9	3	5	7	1	2.1	2	3	0.8	Insourced	0.056	Very Strong
Const.	Preserv	25	1	2.8	3	5	7	1	2.4	2	4	0.4	Insourced	0.319	None
Overall	Preserv	25	1	2.8	3	5	7	1	2.4	3	3	0.4	Insourced	0.315	None
Public	Modern	14	3	3.7	4	5	8	1	3.0	3	5	0.7	Insourced	0.184	Moderate
E&D	Modern	14	3	3.6	4	5	8	2	3.1	3	4	0.5	Insourced	0.103	Strong
Const.	Modern	14	3	3.6	4	4	8	2	3.0	3	4	0.6	Insourced	0.017	Extreme
Overall	Modern	14	3	3.6	4	4	8	2	3.3	3	4	0.4	Insourced	0.142	Strong
Public	Bridge	4	2	3.0	3	4	4	2	2.3	2.5	3	0.7	Insourced	0.353	None
E&D	Bridge	4	3	3.0	3	3	4	4	4.0	4	5	-1.0	Outsourced	0.067	Very Strong
Const.	Bridge	4	3	3.0	3	3	4	4	3.8	4	4	-0.8	Outsourced	0.060	Very Strong
Overall	Bridge	4	3	3.0	3	3	4	4	3.8	4	4	-0.8	Outsourced	0.060	Very Strong

P-value	Interpretation
< 0.05	Extreme evidence
0.05<=P-value<0.10	Very strong evidence
0.10<=P-value<0.15	Strong evidence
0.15<=P-value<0.20	Moderate evidence
0.20<=P-value<0.25	Suggestive evidence
0.25<=P-value<0.30	Weak evidence
> 0.30	No statistical evidence

Definitions
n: number of observations in a subset
p-value: the probability that, by random chance, one could obtain a difference in sample means that is as extreme as or more extreme than the observed.
Confidence Interval: the range of possible values for the difference in means represented by a confidence level
Statistical Evidence: Subjective interpretation of the P-value
Public: Public complexity such as: Contentious ROW acquisition, access management, permitting requirements, political issues, public opinion and involvement, special inspections, etc.
E&D: Engineering and design
Constr.: Construction complexity
Overall: Overall construction complexity

As a way of validating research team perceptions of the relative complexity of bridge, modernization, and preservation projects, the AM ratings for projects in these three categories were analyzed. Not surprisingly, mean values of overall ratings for preservation projects showed lower complexity and with extreme evidence of statistical significance (p-value<0.004). "Public complexity," "design complexity," and "construction complexity" were also significantly lower for preservation projects than for the others. Modernization projects were rated significantly higher (than bridge and preservation projects) in "public complexity" ratings (p-value < 0.004).

3.3.2 Performance metrics for projects in the OTIA I & II non-local-agency database subset

The last updated database available prior to compilation of this final report was dated November 2006. The analyses summarized below are based on that database update. Prior to performing the analyses, the principal investigator met with a representative from ODOT's OPD intimately familiar with the databases from which the data were extracted. Each project was reviewed to determine whether splits and combines had resulted in possibly misleading data. When data were determined to be suspect, projects were deleted from the usable database. The result was a reduction in the size of the database from 74 projects to 44 projects, only 12 of which were outsourced.

The data for the remaining 44 projects in this database subset in November 2006 are presented in Appendix E. Table 3.4 provides a summary of the analysis of budget and schedule performance metrics for the projects of the non-local-agency OTIA I & II database subset.

For modernization projects, there is moderate statistical evidence that the mean construction schedule growth of 4 ODBB projects was less than the mean construction schedule growth of 7 IDBB projects. On average, construction for the ODBB projects was completed 4% ahead of schedule, whereas on average, IDBB projects took 22% longer than originally scheduled. Statistical evidence was weak that 7 IDBB projects had lower growth of construction budgets and total budgets than did 4 ODBB projects. On average, construction costs for ODBB projects exceeded construction budgets by 13%, and total costs exceeded total budgets by 10% for the ODBB projects. For the IDBB projects the mean actual expenditures for construction and for total project costs essentially hit the targets (1.0 and 0.99). These were the only measures showing statistical significance for modernization projects.

For preservation projects, there was strong statistical evidence that the mean total budget growth for 15 IDBB projects (0.88) was less than the value for 4 ODBB preservation projects (1.05).

None of the other comparisons of performance metrics in this database showed statistical significance. There were insufficient bridge projects remaining in the database to allow statistical analysis.

Table 3.4: Non-local-agency OTIA I & II database subset analyses – performance metrics summary

Database Summary	n
Total Observations	**44**
Outsourced Projects	**12**
Insourced Projects	**32**
Preservation Projects	**23**
Modernization Projects	**16**
Bridge Projects	**5**

Note:
1. Schedule data is presented as the ratio of the deviation from the original target to the original target.
2. Budget data is presented as the ratio of the final expenditures to the original target.
3. Second note to third note is presented in days (days from 2nd to 3rd note)

		Insourced					Outsourced					Statistical Conclusions			
Parameter	Type	n	Min	Mean	Med	Max	n	Min	Mean	Med	Max	Diff. in Means	Favorable Delivery	p-value	Statistical Evidence
DSG	MOD	11	-0.57	-0.21	-0.26	0.11	5	-0.49	-0.16	-0.04	0.09	-0.05	INSOURCE	0.821	None
CSG	MOD	7	-0.41	0.22	0.16	0.92	4	-0.18	-0.04	-0.03	0.08	0.26	OUTSOURCE	0.164	Moderate
TSG	MOD	7	-0.38	-0.14	-0.2	0.15	4	-0.45	-0.17	-0.16	0.09	0.03	OUTSOURCE	0.820	None
DBG	MOD	11	0.58	0.97	1	1.14	4	0.95	1.21	1.01	1.87	-0.24	INSOURCE	0.598	None
CBG	MOD	7	0.83	1	1.02	1.24	4	0.99	1.11	1.13	1.19	-0.11	INSOURCE	0.298	Weak
TBG	MOD	7	0.83	0.99	0.99	1.19	4	1.08	1.1	1.1	1.12	-0.11	INSOURCE	0.296	Weak
2nd to 3rd	MOD	6	146	267.17	277	389	2	55	114.5	114.5	174	INSUFFICIENT DATA			
DSG	PRES	15	-0.57	0.23	-0.09	2.57	5	-0.34	-0.06	-0.08	0.19	0.29	OUTSOURCE	0.965	None
CSG	PRES	16	-0.19	0.21	0.01	1.72	5	-0.04	0.04	0	0.19	0.17	OUTSOURCE	0.967	None
TSG	PRES	13	-0.35	0.11	-0.1	1.34	5	-0.18	-0.02	-0.05	0.17	0.13	OUTSOURCE	0.921	None
DBG	PRES	15	0.15	0.93	0.99	1.98	4	0.98	1.09	1	1.4	-0.16	INSOURCE	0.335	None
CBG	PRES	18	0.45	0.84	0.84	1.14	4	0.78	1.01	0.84	1.58	-0.17	INSOURCE	0.580	None
TBG	PRES	15	0.51	0.88	0.85	1.19	4	0.85	1.05	0.85	1.41	-0.17	INSOURCE	0.147	Strong
2nd to 3rd	PRES	15	30	218.13	201	508	4	136	283.3	209.5	578	-65.12	INSOURCE	0.597	None
DSG	BRIDGE	3	-0.22	-0.08	-0.14	0.11	2	-0.15	-0.12	-0.12	-0.09	INSUFFICIENT DATA			
CSG	BRIDGE	3	-0.29	-0.05	0.01	0.14	1	-0.28	-0.28	-0.28	-0.28	INSUFFICIENT DATA			
TSG	BRIDGE	3	-0.24	-0.15	-0.09	0.13	1	-0.22	-0.22	-0.22	-0.22	INSUFFICIENT DATA			
DBG	BRIDGE	3	0.69	0.9	1	1	1	0.82	0.82	0.82	0.82	INSUFFICIENT DATA			
CBG	BRIDGE	3	0.68	1.15	1.15	1.61	1	0.63	0.63	0.63	0.63	INSUFFICIENT DATA			
TBG	BRIDGE	3	0.68	1.14	1.14	1.59	1	0.65	0.65	0.65	0.65	INSUFFICIENT DATA			
2nd to 3rd	BRIDGE	3	177	294	208	497	1	241	241	241	241	INSUFFICIENT DATA			

P-value	Interpretation
< 0.05	Extreme evidence
0.05<=P-value<0.10	Very strong evidence
0.10<=P-value<0.15	Strong evidence
0.15<=P-value<0.20	Moderate evidence
0.20<=P-value<0.25	Suggestive evidence
0.25<=P-value<0.30	Weak evidence
> 0.30	No statistical evidence

Definitions
n: number of observations in a subset
p-value: the probability that, by random chance, one could obtain a difference in sample means that is as extreme as or more extreme than the observed.
Confidence Interval: the range of possible values for the difference in means represented by a confidence level
Statistical Evidence: Subjective interpretation of the P-value
DSG: Design schedule growth = [Actual design schedule (days) - Planned design schedule (days)]/ Planned design schedule (days)
CSG: Construction schedule growth = [Actual construction schedule (days) - Planned construction schedule (days)]/ Planned construction schedule (days)
TSG: Total schedule growth = [Actual total schedule (days) - Planned total schedule (days)] / Planned total schedule (days)
DBG: Design budget growth= [Actual dollars spent on design - Planned dollars for design] /Planned dollars for design
CBG: Construction budget growth = [Actual dollars spent on construction - Planned dollars for construction] / Planned dollars for construction
TBG: Total budget growth = [Actual dollars spent on total project - Planned dollars for total project] / Planned dollars for total project
2nd to 3rd: Days from second to third note

3.4 PROJECT CHANGE ORDER DATABASE SUBSET

ODOT's Construction Unit keeps records of change order activity on all projects, both insourced and outsourced. This change order information was made available to the research team for 128 projects, 14 of which were outsourced. Table 3.5 provides a summary of the analysis of the change order database subset. Appendix F provides the information used for these analyses. Two parameters were calculated using the database information. The ratio of the dollar value of change orders to the dollar value of the construction contract expressed as a percent is identified as %CO$. Popular opinion is that projects with lower percentages of expenditures for change orders are better projects.

Values of CO Rate (change order rate) were also calculated as the number of change orders per $1million of original construction contract value. It is doubtful that this measure is meaningful. Does it really matter if the total dollar value of change orders for a project is accounted for by few or many individual change orders? Nonetheless, in a desire to consider all possible meaningful relationships, values for this measure were compared for IDBB and ODBB projects.

There were insufficient ODBB modernization projects from which to draw conclusions. Comparisons of IDBB and ODBB bridge projects produced no valid results.

There is extreme statistical evidence that the dollar amount of change orders expressed as a percent of original contract value is lower for the 61 IDBB preservation projects than for the 6 ODBB preservation projects. Most project administration professionals would see this as a vote in favor of insourcing preservation projects. There is also extreme statistical evidence that IDBB preservation projects produce fewer change orders per $ million of original contract value than do projects delivered ODBB, although it is doubtful that this is meaningful information.

Table 3.5: Change order database subset analyses summary

Database Summary	n
Total Observations	**125**
ODBB Projects	**11**
IDBB Projects	**114**
Perservation Projects	**67**
Modernization Projects	**33**
Bridge Projects	**25**

		Insourced					Outsourced					Statistical Conclusions			
Parameter	Type	n	Min	Mean	Med	Max	n	Min	Mean	Med	Max	Diff. in Means	Favorable Delivery	p-value	Statistical Evidence
%CO$	MOD	23	-2.58	4.29	3.28	14.5	2	1.96	4.06	4.06	6.16	0.23	Outsourced	Insufficient data	
CO rate	MOD	23	0.47	5.3	3.8	20.83	2	4.64	6.8	6.8	8.87	-1.5	Insourced	Insufficient data	
%CO$	PRES	61	-6.93	4.21	1.24	82.48	6	1.64	6.52	4.17	14.65	-2.31	Insourced	0.023	Extreme
CO rate	PRES	61	0.34	3.9	2.9	21.56	6	2	6.5	7	9.92	-2.6	Insourced	0.034	Extreme
%CO$	BRIDGE	30	-2.55	6.68	1.58	50.23	3	0	7.51	9.67	12.86	-0.83	Insourced	0.5073	None
CO rate	BRIDGE	30	0.38	9.3	6.2	40	3	2.17	6.3	4.1	12.53	3	Outsourced	0.684	None

P-value	Interpretation
< 0.05	Extreme evidence
0.05<=P-value<0.10	Very strong evidence
0.10<=P-value<0.15	Strong evidence
0.15<=P-value<0.20	Moderate evidence
0.20<=P-value<0.25	Suggestive evidence
0.25<=P-value<0.30	Weak evidence
> 0.30	No statistical evidence

Definitions
n: number of observations in a subset
p-value: the probability that, by random chance, one could obtain a difference in sample means that is as extreme as or more
Confidence Interval: the range of possible values for the difference in means represented by a confidence level
Statistical Evidence: Subjective interpretation of the P-value
%CO$: Total dollars in change orders / Total project cost
CO Rate: The number of change orders per million dollars of original contract value, (i.e. (number of change orders / total dollar amount) * 10 ^6

3.5 DATABASE SUBSET OF AREA MANAGERS' RATINGS OF PROJECT SUCCESS

Because of research team concerns about the validity of the "objective" data in the non-local-agency OTIA I and II database subset, and because of the small size of the usable database, the research team, in consultation with the TAC, decided to obtain subjective ratings of project performance in the expanded database from ODOT's Area Managers. Projects that had been split and/or combined and projects ending before 1999 were not included, resulting in a database subset of 128 projects. Again, Area Managers were chosen to do the ratings because of their overall perspective on how well a project met ODOT's objectives for a project.

In addition to ratings of cost and schedule performance, AM's would be able to make a determination of the quality of the delivered projects – how well they met the objectives set for the projects at the time of their initiation. Area managers were asked to subjectively rate the budget, schedule, quality and overall performance for each of the projects in their jurisdiction. This data was added to the ODOT project delivery database and analyzed using the same statistical tools as used on the other data.

An example of the form used to obtain ratings from each AM is shown in Figure 3.3. In hopes of improving the response rate and making responses as simple as possible for AM's, the projects that were in the jurisdiction of each AM were identified and entered into each AM's rating sheet, so that each AM would only see the names of their projects.

Area Manager	June Carlson				1 = very poor; 5 = very good			
Key Number	Description	Let Date	I do not remember / Do not have information on this project	Budget Performance	Schedule Performace	Project Meet Intended Goals?	Overall Rating of Project Delivery	Comments
			X	SCORE 1 - 5	SCORE 1 - 5	SCORE 1 - 5	SCORE 1 - 5	
11939	OR35: JCT. HOOD RIVER HWY - POLALLIE CREEK	5/12/2005						
11940	OR 35: LONG PRAIRIE RD - ODELL HWY	2/24/2005						
10689	WRIGHT CREEK BR. #3041 @ MP 12.72	6/27/2002						
11125	HULT ROAD - HILLOCK BURN ROAD	3/28/2002						
11130	TIMBERLINE ROAD SECTION	2/28/2002						
11862	OR213: OR211 JCT-GARRETT CREEK	1/23/2003						
11912	ZIGZAG - RHODODENDRON (PHASE 1)	8/22/2002						
12108	EAST PORTLAND FWY - ROCK CREEK SECTION	10/25/2001						
12391	GOVERNMENT CAMP LOOP ROAD RESURFACING	8/29/2002						
12837	I-5: WILSONVILLE RD. - WILLAMETTE RIVER	3/30/2007						
12855	OR99E: KELLOGG CR.- MP 9.19	1/25/2007						
12872	OR224: SE 17TH - EAST PORTLAND FWY	2/23/2006						
12874	I205: WILLAMETTE RIVER BR - PACIFIC HWY	4/20/2006						

Figure 3.3: Form for ratings of project cost, schedule, and quality performance by ODOT Area Managers

Table 3.6 presents a summary of the analyses of AM ratings of cost, schedule, and quality performance of each of the projects in the AM rating database subset. Appendix G contains the data upon which these analyses are based. With only 12 outsourced projects in this database subset, it is not surprising that none of the comparisons of insourced and outsourced projects produced statistical significance at a level that the research team believed was meaningful. Even ignoring statistical significance, the values of the differences in the means between ratings of insourced and outsourced projects on all criteria showed little differentiation. In the eyes of ODOT's AM's -- the individuals who should be ODOT's most knowledgeable and discerning customers for delivered design and construction projects -- to-date, there has been no perceived difference in the cost performance, schedule performance, or end products.

Table 3.6: Summary of analyses of ODOT Area Manager performance ratings

Database Summary	n
Total Observations	**186**
Outsourced Projects	**12**
In-House Projects	**174**
Perservation Projects	**46**
Modernization Projects	**51**
Bridge Projects	**89**

Please note: Data was collected using the Likert scale, where 1 = very poor performance and 5 = exceptional performance

		Insourced					Outsourced					Statistical Conclusions			
Parameter	Type	n	Min	Mean	Med	Max	n	Min	Mean	Med	Max	Diff. in Means	Favorable Delivery	p-value	Statistical Evidence
Budget	Modern	45	1	3.6	4	5	6	2	3.7	3	5	0.1	Insourced	0.9094	None
Budget	Preserv	46	1	3.6	4	5	0	NA, n=0				Insufficient Data			
Budget	Bridge	83	1	3.5	4	5	6	2	3.7	4	5	0.1	Insourced	0.8885	None
Schedule	Modern	45	1	3.8	4	5	6	3	3.7	3	4	0.1	Insourced	0.4416	None
Schedule	Preserv	46	1	3.8	4	5	0	NA, n=0				Insufficient Data			
Schedule	Bridge	83	1	3.3	4	5	6	2	4.0	4	5	0.3	Outsource	0.668	None
Goals	Modern	45	2	4.3	4	5	6	3	4.0	3.5	5	0.2	Insourced	0.806	None
Goals	Preserv	46	2	4.0	4	5	0	NA, n=0				Insufficient Data			
Goals	Bridge	83	2	3.9	4	5	6	2	4.7	4	5	0.1	Insourced	0.4053	None
Overall	Modern	45	2	4.0	4	5	6	3	4.0	4	5	0.1	Insourced	0.923	None
Overall	Preserv	46	2	4.0	4	5	0	NA, n=0				Insufficient Data			
Overall	Bridge	83	2	3.9	4	5	6	2	4.0	4	5	0.1	Insourced	0.871	None

P-value	Interpretation
< 0.05	Extreme evidence
0.05<=P-value<0.10	Very strong evidence
0.10<=P-value<0.15	Strong evidence
0.15<=P-value<0.20	Moderate evidence
0.20<=P-value<0.25	Suggestive evidence
0.25<=P-value<0.30	Weak evidence
> 0.30	No statistical evidence

Definitions
n: number of observations in a subset
p-value: the probability that, by random chance, one could obtain a difference in sample means that is as extreme as or more extreme than the observed.
Confidence Interval: the range of possible values for the difference in means represented by a confidence level
Statistical Evidence: Subjective interpretation of the P-value

3.6 STIP DELIVERY

As discussed in the interim report (*Rogge, et. al. 2003*), in addition to %CE and %PE, ODOT's Office of Project Delivery has chosen "STIP Delivery" as an overall performance indicator. STIP is an acronym for the Statewide Transportation Improvement Program. STIP delivery is defined as the percent of projects that are let within 90 days of the scheduled bid date.

Comparing IDBB and ODBB bridge, modernization, and preservation projects in the STIP Delivery database subset produced the results shown in Table 3.7. Because of the low number of outsourced projects in this database subset, it was not possible to make statistically meaningful conclusions.

Table 3.7: STIP delivery

Database Summary	n
Total Observations	**168**
Outsourced Projects	**14**
In-House Projects	**154**
Perservation Projects	**108**
Modernization Projects	**24**
Bridge Projects	**36**

		Insourced					**Outsourced**					**Statistical Conclusions**			
Parameter	Type	n	Min	Mean	Med	Max	n	Min	Mean	Med	Max	Diff. in Means	Favorable Delivery	p-value	Statistical Evidence
STIP-90	MOD	19	0	0.79	1	1	5	0	0.80	1	1	-0.01	Outsourced	Not Applicable*	
STIP-90	PRES	101	0	0.85	1	1	7	1	1.00	1	1	-0.15	Outsourced	Not Applicable*	
STIP-90	BRIDGE	34	0	0.85	1	1	2	0	0.50	0.5	1	0.35	Insourced	Not Applicable*	
*Standard statistical tests are not appropriate for binary data															

P-value	Interpretation
< 0.05	Extreme evidence
0.05<=P-value<0.10	Very strong evidence
0.10<=P-value<0.15	Strong evidence
0.15<=P-value<0.20	Moderate evidence
0.20<=P-value<0.25	Suggestive evidence
0.25<=P-value<0.30	Weak evidence
> 0.30	No statistical evidence

Definitions
n: number of observations in a subset
p-value: the probability that, by random chance, one could obtain a difference in sample means that is as extreme as or more
Confidence Interval: the range of possible values for the difference in means represented by a confidence level
Statistical Evidence: Subjective interpretation of the P-value
STIP-90: A value of 1 indicates that a project was completed within 90 days of the planned project end date (i.e. If actual 2nd note - planned 2nd note <= 90, a project is designated "1", otherwise "0")

There were only two ODBB bridge projects in this database subset. One met STIP delivery and one did not. Eighty-five percent of IDBB bridge projects met STIP delivery. Four of five ODBB modernization projects met STIP delivery, which is similar to the 79% achievement of nineteen IDBB modernization projects. All seven ODBB preservation projects met STIP delivery. Eighty-five percent of IDBB preservation projects achieved STIP delivery targets.

3.7 SUMMARY AND CONCLUSIONS FROM ANALYSES OF THE DATABASE

3.7.1 Summary of findings

The following summarizes the findings from the analyses of all database subsets:

1. There is extreme statistical evidence that the mean value of %CE for insourced modernization projects is lower than the mean value for outsourced modernization projects.

2. There is moderate statistical evidence that the mean value of %CE for insourced preservation projects is lower than the mean value for outsourced preservation projects.

3. There is weak statistical evidence that the mean value of %PE for insourced preservation projects is lower than the mean value for outsourced preservation projects.

4. Using the research team's parameters for meaningful statistical significance, there is no difference in means of %PE for modernization or bridge projects.

5. There is suggestive statistical evidence that construction contractors rated completeness of design presentation higher for ODBB bridge projects than for IDBB bridge projects.

6. There is weak statistical evidence that construction contractors rated constructability of design higher for ODBB bridge projects than for IDBB bridge projects.

7. There is extreme statistical evidence that ODOT's AMs rated preservation projects less complex than bridge and modernization projects.

8. There is extreme statistical evidence that ODOT's AMs rated complexity of public factors for modernization projects higher than for bridge or preservation projects.

9. Overall, ODOT's AMs see no difference in complexity of the IDBB and ODBB preservation projects.

10. Overall, there is strong statistical evidence that ODOT's AMs rate the complexity of the IDBB modernization projects higher than the ODBB modernization projects.

11. Overall, there is very strong statistical evidence that ODOT AMs rate the complexity of the ODBB bridge projects higher than the IDBB bridge projects.

12. There is moderate statistical evidence that ODBB modernization projects show lower construction schedule growth than IDBB modernization projects.

13. There is weak statistical evidence that IDBB modernization projects show lower construction budget growth than ODBB modernization projects.

14. There is weak statistical evidence that IDBB modernization projects show lower total budget growth than ODBB modernization projects.

15. There is strong statistical evidence that IDBB preservation projects show lower total budget growth than ODBB preservation projects.

16. There is extreme statistical evidence that the dollar amount of change orders expressed as a percent of original contract value is lower for insourced preservation projects than for outsourced preservation projects in the change order database subset.

17. There is extreme statistical evidence that the number of change orders per dollar of original contract value is less for insourced preservation projects than for outsourced preservation projects. This measure is not considered meaningful however.

18. There is no statistical evidence of differences in AM ratings of budget performance, schedule performance, achievement of project goals, and overall performance for the 168 insourced and 12 outsourced projects rated by the AMs.

19. The number of ODBB projects for which STIP Delivery achievement could be compared with STIP Delivery for IDBB projects was small and did not show statistical differences between ODBB and IDBB delivery for bridge, modernization, or preservation projects.

3.7.2 Conclusions from analyses of the database

1. Table 3.8 summarizes the findings listed above that bear directly on decisions to insource or outsource PE, CE, or both functions on bridge, modernization, or preservation projects. It may be seen that if only statistically significant results are considered, there is a preference to insource PE and CE for preservation projects as often as internal resources allow and a preference to make outsourcing of PE for bridge projects the first choice when outsourcing PE becomes necessary. For modernization projects, analyses of data make a weak recommendation for insourcing PE and CE.

Table 3.8: IDBB/ODBB preferences

	PE	Non-specific to PE or CE	CE
Bridge	O – GC ratings – completeness of design O – GC ratings - constructability		
Modernization		O- Construction Sched. Growth I – Construction Budget Growth I – Total Budget Growth	I – %CE
Preservation	I - %PE I - % change order $	I – Total Budget Growth	I - %CE

I = Insourced-Design-Bid-Build Preference
O = Outsourced-Design-Bid-Build Preference

2. Although Table 3.8 shows that some preferences for insourcing and outsourcing PE and CE may be inferred from the statistical analyses, it is the opinion of the principal investigator that the most significant finding is that in the eyes of the ODOT AMs (the best representatives of the customer for project delivery services), there is no difference in performance between IDBB or ODBB delivery. This may be

interpreted to mean that when there is an opportunity to choose between outsourcing and insourcing, the decision to outsource or insource should be based on cost. In the research project, cost is measured by %PE and %CE. For preservation projects both %PE and %CE favor insourcing. CE cost comparisons showed an advantage for IDBB delivery of CE for modernization projects. For bridge and modernization projects, there is no statistically valid difference in PE and CE costs between delivery methods.

3. As ODOT delivers more outsourced projects, it is likely that statistically valid differences in %PE and %CE will emerge for delivery of all project types. If that happens, this information should be used in determining optimum internal project delivery infrastructure and organization size for future project work loads.

4.0 AREA MANAGER INTERVIEW SUMMARY

Interviews with ODOT's Area Managers were conducted to provide the research team with an understanding of the factors that promote the successful outsourcing of projects. The intent of these interviews was to subjectively determine the following:

- Differences in the performance of IDBB, ODBB, and DB delivery for different project types;
- Project characteristics that lend themselves to successful outsourcing, and project characteristics that are problematic; and
- Strategies that Area Managers suggest for the outsourcing process.

ODOT's Area Managers became the focus of the research because they represent the level of oversight present on all IDBB, ODBB, and DB projects that is closest to the work of delivering projects. They are familiar with the entire project delivery process from conception, to completion, to maintenance. For insourced projects, Project Leaders report to Area Managers for PE, and Project Managers report to Area Managers for CE. For outsourced projects, Consultant Project Managers (CPMs) are ODOT employees reporting to Area Managers for both PE and CE on their outsourced projects. AMs are thus in the best position to determine how well the delivery of projects is meeting ODOT's objectives for quality, cost, and schedule.

During the winter of 2006 the ODOT Area Managers and members of the ODOT project delivery teams were interviewed to determine their opinions regarding the strategy for outsourcing project delivery. All area managers with experience with outsourcing were targeted for interviews. Some interviews were conducted in-person while others (in more remote locations) were conducted via telephone.

In this phase, 12 two-hour interviews were conducted. In addition to interviews with ten ODOT Area Managers, the ODOT design-build coordinator and an ODOT consultant Project Manager (CPM) were interviewed on the recommendation of the Technical Advisory Committee overseeing this study.

4.1 INSOURCING AND OUTSOURCING BY PROJECT TYPE

One objective of this phase of the research was to determine if there was a significant difference in performance between insourced and outsourced projects for each project type (i.e. bridge, modernization or preservation). Unfortunately, there was not a clear consensus on the topic.

4.1.1 Bridge

Six interviewees indicated that bridge projects are good to outsource because they are easily defined. Bridge designers working for consulting engineers are also generally very bright engineers that have many creative ideas. The high quality work provided by the consultants and the lack of issues for that project type is a good indication that bridges are good for outsourcing. However, four interviewees indicated that keeping bridge projects in-house is essential to maintaining a savvy ODOT design team.

4.1.2 Preservation

Three interviewees believed that outsourcing preservation projects was acceptable unless they are very complex. As a general rule, preservation projects are simple and easy to define. They also usually do not require utility relocation or ROW acquisition.

4.1.3 Modernization

There was no consensus for this project type. Modernization projects are sometimes very complex and uncertain, which can be problematic for consultants if the scope is not well-defined. Conversely, well-defined modernization projects have been completed efficiently and under budget by consultants on many occasions.

4.2 ELEMENTS TO BE CONSIDERED IN ASSIGNING THE PROJECT DELIVERY METHOD

This section of the report is organized by summarizing each specific element that interviewees felt should be considered when selecting the project delivery method. Each element will be introduced by a question that one should consider (e.g., “Is the project schedule-sensitive?”) followed by the interviewees’ opinions concerning the ‘if, then’ strategy that should be employed.

4.2.1 Is the project extraordinarily schedule-sensitive?

If the answer to this question is a resounding ‘yes’, the project should be delivered via the Design-Build project delivery method. There was consensus among interviewees (12 of 12 agreed) that the design-build method is appropriate for schedule-sensitive projects, provided that the scope is well-defined and required design alternatives are kept to a minimum. Projects that are not well-defined should be delivered via the traditional Design-Bid-Build method or refined further and then delivered via Design-Build.

An interview with Bob Burns of the ODOT Office of Project Delivery suggests that this is the first question that should be asked during the ODOT project delivery process. There is significant empirical evidence in addition to ODOT experience that suggests that design- build is the most schedule-efficient delivery method (*Rogge, et al. 2003*). While there has not been clear evidence that points to lower project costs or to an increase in quality, Mr. Burns concludes from his experience at ODOT with DB that it is efficient in reducing overall project duration by as much as a year.

Projects which must be delivered as early as possible are best suited for design-build. In addition, Mr. Burns has found that incentives for early completion can further reduce project duration. When using schedule incentives, one should take care to ensure that the incentive schedule matches the intrinsic value that ODOT expects from the incremental reduction in schedule.

One important note about design-build is that it is often challenging in scenarios where political pressure is anticipated to affect the project boundaries, operations or design. As Bob Burns states, “Changing a Design-Build project once the project has begun is like trying to steer an aircraft carrier. It is neither quick nor efficient. Design-build projects need to be completely defined *before* the start of the project and let to run their course.” (*Burns 2006*).

If a project is not extremely schedule sensitive or is budget sensitive, the collective recommendation from the interviewees is that the project should not be delivered DB. Instead, IDBB or ODBB should be used.

4.2.2 Does ODOT have the technical capability (CE and PE) to deliver the project insourced?

This seemingly simple question is often the only question necessary to determine the delivery process for a project. If the answer to this question is ‘no,’ eleven of twelve interviewees agree that the project must be outsourced. ODOT cannot carry a high volume of employees during times of peak project volume and reduce capacity as demand reduces. In fact, the State of Oregon has mandated that ODOT must maintain a consistent volume of employees and may not hire additional employees to meet demand. Therefore, ODOT must outsource a portion of work when demand exceeds capacity.

The design capabilities vary among the regional and district offices ODOT has around the state. Some areas may be strong in one discipline, such as bridge design, where others are stronger in another, such as landscape design.

For example, in Region 4, as of this writing there simply is not a bridge design unit within ODOT. Therefore, when a bridge project is encountered it must be outsourced. Other regions have limited technical staff in other disciplines such as pavement design, geotechnical design or traffic controls. Simply put, if ODOT does not have the staff to complete the project, ODOT can not reasonably deliver the project IDBB.

In some cases, augmenting the ODOT staff with a few consultants who perform specific tasks in an otherwise insourced project has been very successful. This process requires clear definition of the work expected of the consultant and adequate communication between the ODOT Project Leader and the consultant. If communication falters, the project’s success can be jeopardized. If utilizing an augmented staff is not reasonable, the project should be put in the ODOT inventory of outsourced projects.

Several Area Managers indicated that ODOT does not share capacity among areas. That is, excess capacity in one area may not be used to supplement another area that has high demand. Five interviewees indicated that many projects are unnecessarily outsourced. If employee sharing were allowed, ODOT's design capacity would be more consistent, and ODOT would come closer to realizing the full potential of its employees. As the system stands, an area must outsource a project if the Region office does not have the technical capacity to deliver the project.

4.2.3 Does the project appear to have a significant number of right-of-way (ROW) acquisition tasks?

The majority of the interviewees indicated that projects should be kept in-house if they appear to have potentially high levels of ROW acquisition tasks. Many Area Managers (7 of 10) have experienced various difficulties related to outsourcing the ROW acquisition for a project. Many Area Managers simply say that, "It's not worth it; ODOT should keep this function in-house." Others recognize the challenges that consultants face with the process; and others even indicate that ROW acquisition is something consultants could do even better than ODOT with proper training and flexibility.

The work order contract is the main barrier for consultants to overcome in the ROW acquisition process. Unlike ODOT, consultants have restrictions on schedule and budget associated with the process and must finish the task within boundaries. It is well known that the ROW acquisition process is very sensitive and can be delayed by stubborn land owners. Where ODOT would simply float the schedule to avoid litigation (condemnation), consultants cannot do this. Rather than take extra time and risk a poor performance review by ODOT for violating the work order contract, consultants will often recommend condemnation where ODOT would have been able to negotiate. This practice is at the root of why the majority of ODOT Area Managers view right-of-way acquisition as a task best kept in-house.

The second challenge for consultants is that ROW acquisition is extremely sensitive and specific processes must be followed. Consultants are often not trained in the process and must 'learn as they go.' Several Area Managers suggest workshops sponsored by ODOT to train consultants. Lastly, where ODOT typically has a feel for projects that are going to have challenging ROW issues, this information should be conveyed to consultants or ODOT should do this process in-house.

In most cases Area Managers agree that ROW acquisition is one of the first factors they examine when deciding on the project delivery process. Because ROW acquisition typically goes much more smoothly insourced, due to a very proficient, experienced and dedicated ROW staff, Area Managers often keep these projects. In contrast, some Area Managers (3 of 10) believe that as outsourcing increases, consultants will need to be trained in ROW acquisition. These individuals suggest both workshops and letting consultants 'cut their teeth' on projects that are not as schedule or budget sensitive. One should note that most engineering consulting firms delivering ODOT projects strongly disagree with these statements. This data will be provided later in the report.

4.2.4 Does the project appear to have a significant amount of utility work?

Similar to ROW acquisition, it is the opinion of the majority of Area Managers that ODOT is typically more efficient than consultants with projects that require significant utility relocation. Eight of twelve interviewees indicated that projects with significant utility coordination were better delivered in-house; one of twelve indicated that utility phase performance would be better if the project were outsourced; two of twelve indicated that the efficiency of utility work was independent of project delivery method; and one of twelve had no opinion on the matter.

Those favoring in-house delivery of projects with significant utility work indicated that it is simply easier for public agencies to communicate with one another than for a private-sector consultant. Several area managers indicate that the “we owe you one” system is in place between ODOT and utility companies. This allows ODOT to move up in the list where consultants are on a first-come-first-served system.

This is not to say that consultants are not good at utility work, and that they are not efficient communicators. It is simply that ODOT typically has more influence with utility agencies. Because of ODOT’s relative efficiency with the process, these projects are preferred by Area Managers to be kept in-house.

4.2.5 Is the project unusually politically sensitive?

Eight of ten interviewees agreed that projects that are politically sensitive, require numerous community meetings, or are being watched closely by the public are typically better to keep insourced for several reasons. First, these projects require communication with the public. ODOT managers see risk in allowing consultants to speak directly with the public. Where ODOT has a customer relations staff, consultants may not have a staff that works in a similar capacity. Keeping these projects insourced allows ODOT to maintain control over their image, a very important asset.

Second, projects that are in the political spotlight usually have been developed by the Area Manager and local elected officials. Therefore, the Area Managers, who are in direct communication with their internal staff, can maintain the project goals that they helped to develop with the elected officials. Outsourcing such projects potentially limits the Area Manager’s control over these goals.

4.2.6 Does the project allow for a great number of alternatives?

While this topic was not discussed with all interviewees, every individual that did respond (7 of 7) agreed that projects that are not clearly defined are not suitable for outsourcing. Perhaps the biggest difficulty with consultants is when they provide ODOT with designs that are not what ODOT expected. This can occur in a variety of ways. For example, a consultant may design several alternatives, or an alternative that ODOT did not expect, which is entirely within their work order contract. Similarly, consultants may explore the project in more detail and take more time than ODOT would because they are concerned with their work order contract. Lastly, consultants may design beyond the capacity/budget expected by ODOT. The common theme with all of these issues is the work order contract and a lack of specific information provided by ODOT.

As one Area Manager said, “consultants will do exactly what you ask of them. If you want something done, put it in the work order contract and communicate effectively. They know work order contracts better than the ODOT employees that wrote them.” If ODOT wants something specific done they need to ask for it; if not, ODOT must expect the range of designs that may be provided as bounded by the work order contract. This being said, consultants often do have some problems associated with projects that are simply impossible to completely define.

Some projects, especially modernization projects, are difficult to define and may inherently contain a significant number of alternatives. These projects are inappropriate for consultants, because ODOT has a better idea of what alternative will work within the larger system. Consultants are better suited for bridge projects and simple modernization projects where the work order contract is clearly and specifically defined. Under these circumstances consultants are often much more efficient and cost effective than ODOT.

4.2.7 Work order contract

The work order contract (WOC) has been mentioned a variety of times thus far. Nine of ten Area Managers indicated that consultants will follow this document as they would in a private sector job. The work order contract defines the work to be done, determines the consultant’s budget and schedule, and dictates the responsibilities of the firm. Once the budget and schedule have been set, changing the work order contract can be very problematic for the consultant. Requesting changes during the project is significantly worse because of reluctance by ODOT to issue change orders.

Projects where ODOT anticipates changes to the work order contract due to political, environmental or other factors should NOT be outsourced with current WOC procedures. This type of project can be a major frustration for the consultant, and the extra costs will be passed on to ODOT.

4.2.8 Overall ODOT strategy

Over the past 10 years ODOT has begun to outsource a significant amount of its PE. With this trend, ODOT has lost a significant number of its better technical employees to private consultants. One must ask when deciding which projects to keep and which to outsource, will the projects kept insourced help ODOT to retain its better employees and keep them technically savvy and motivated?

Six of ten Area Managers agreed that maintaining proficient employees is a definite concern that must be addressed when deciding which projects to keep insourced. Several suggestions include keeping interchanges in-house as much as possible, interesting intersections, I-5 work, and projects that have grade changes. Keeping interesting projects for one’s employees is essential. In the opinion of interviewees, consultants will do the work that they get and are happy performing simple, easy-to-define projects. It is the complicated projects that keep ODOT's internal staff happy, savvy and interested in working for ODOT.

4.3 ADDITIONAL COMMENTS

As expected, Area Managers had an array of concerns with the outsourcing process. While most Area Managers focused on the main concerns defined in the preceding pages of this chapter, there were many secondary concerns that bear mentioning.

4.3.1 Guidance and training of ODOT consultants

Six interviewees indicated that ODOT needs to provide consultants with guidance, both during the project and during the planning phases. The better the communication in all phases, the better the project will perform. ODOT also needs to educate consultants about the structure and format of their expected work product and what ODOT resources are available to them.

One problem experienced by an Area Manager was poor communication within ODOT regarding an outsourced project and poor communication between ODOT and the consultant. Although consultants are often very sensitive to the needs of stakeholders, ODOT employees tend to be more accessible. In other words, ODOT employees are typically more responsive to the questions and concerns of other project team members and project stakeholders. ODOT employees tend to identify responding to the concerns of the public and other project team members as a vital part of their job function. Furthermore, the consultants may not have access to, or recognize the value of, experienced ODOT staff. Lack of communication with consultant employees allows projects to slip behind schedule and poor communication may be used as an excuse.

Consultant training is typically performed by ODOT for the outsourcing process. While significant time and money is invested in educating consultants, many processes and work product formats are so specific and rigid that consultants often do not get it right the first time. The time required to fix errors after the design phase is completed can be significant.

The issues discussed above are being addressed jointly by ODOT and ACEC Oregon (American Council of Engineering Companies of Oregon). With this team approach, the learning curve for consultants working with ODOT should be accelerated.

4.3.2 Location of work

This topic was identified by four interviewees. Consultant proximity is a major problem for the Area Managers located in rural areas and cited as a major benefit for Area Managers located near city centers. The vast majority of consulting engineers providing project delivery services for ODOT are located near major Oregon cities, specifically Portland, Salem, and Eugene.

Managers agree that it is ideal to have consultants who are physically located near the worksite. Projects are often successful when the consultants are located far away, but the general rule is that consultants who are close to the work site not only have less travel time but generally have experience with the community and traffic flow. This can be a subtle difference but can affect project performance significantly.

4.3.3 Projecting the ODOT image

Three interviewees expressed concern about outsourcing projects that have a large impact on ODOT's image. In many areas, ODOT attempts to maintain involvement with all community affairs. ODOT Areas will often outsource a project but will remain heavily involved in community meetings in order to promote the ODOT image. Supplementing a consultant's effort can often be very costly and essentially results in a double-charge for community meetings. Therefore, it makes sense for ODOT to either keep projects insourced that are going to require a significant number of community meetings, or to make the ability of the consultant to deal with the public a very important criterion in selecting the consultants for such projects.

Interviewees noted that ODOT involvement in community meetings provides the opportunity to manage and protect the ODOT image. Area Managers cited several examples in past projects where poor performance of consultants in community meetings was linked to a negative public perception of the quality of ODOT's project delivery and administration. According to several Area Managers, the Portland region has not experienced any problems with their consultants, because they are in touch with their community (most are Portland based). ODOT's community affairs personnel take care of creating all presentations, and any presentation at a community meeting is a joint effort between the consultant and ODOT.

4.3.4 Surveying and mapping

Two interviewees expressed the opinion that surveying and mapping work can be problematic when outsourced, because of the various computer programs available to consultants, methods for presenting drawings, and benchmarking techniques. ODOT has strict requirements for the format of the consultant's survey and mapping work products. Often, consultants do not adequately submit documents in the required format.

4.3.5 High risk projects

Two interviewees expressed the opinion that ODOT should retain high risk projects when ODOT maintains the highest level of control over the risk. In other words, if ODOT is more capable of reducing the probability or severity of risk events for a project than their consultant counterparts, ODOT should avoid outsourcing the project. Risk management theory suggests that the entity with the most control over the risk should maintain the burden of the risk. Transferring this risk to a second or third party decreases financial and contractual efficiency, because ODOT will end up paying for the risk through increases in the design budget or through default of the consultant.

One issue with delivering DB is ODOT's lack of ability to review design documents during the design process. Because the documents are created for the constructor, sometimes on a "just-in-time" schedule, ODOT cannot reasonably review documents. This limits ODOT's capability to control the project once it gets going.

4.4 SUMMARY OF INTERVIEWS WITH ODOT'S AREA MANAGERS

4.4.1 Summary of findings

The findings from analyses of the information obtained through interviews with ten ODOT Area Managers, the ODOT design-build coordinator, and an ODOT Consultant Project Manager are summarized below:

1. Six of ten interviewees agree that bridge projects are good projects for outsourcing, particularly in light of ODOT's current bridge design resources.

2. Four of ten interviewees believe that it is necessary for ODOT to retain some bridge projects insourced in order to build and maintain an adequate level of bridge design expertise within ODOT.

3. Three of ten interviewees believe that although not a preferred strategy, outsourcing of preservation projects is acceptable if internal resources are not available.

4. Decisions regarding outsourcing of modernization projects need to be made on a project-by-project basis with factors such as need for public involvement, ROW acquisition, utility work, and the likelihood of significant scope changes playing the dominant role.

5. Twelve of twelve interviewees agree that DB delivery has advantages for projects that must be delivered on an aggressive schedule.

6. The collective recommendation from the interviews is that if schedule sensitivity is normal, IDBB or ODBB project delivery is preferred over DB.

7. Eleven of twelve interviewees agree that if ODOT does not have internal resources available for a project, the project must be outsourced.

8. Five of twelve interviewees believe that some projects are being unnecessarily outsourced because of restrictions on sharing design resources between Regions.

9. Seven of ten Area Managers have experienced difficulties related to outsourcing ROW acquisition.

10. The view of a minority of Area Managers interviewed is that the potential exists for engineering consultants to do a better job of ROW acquisition than insourced ROW acquisition if their contracts provide more flexibility and if they have proper training.

11. Eight of twelve interviewees believe that projects with significant utility coordination are best insourced, primarily because of greater perceived influence on utility companies by ODOT than by individual engineering consultants.

12. Twelve of twelve ODOT management interviewees believe that projects with high political sensitivity, requiring numerous community meetings, or that are being watched closely by the public are best insourced.

13. Seven of seven ODOT management interviewees believe that projects that are not clearly defined should not be outsourced, due to the nature of the work order contract.

14. Projects where ODOT anticipates changes to the work order contract due to political or environmental factors should not be outsourced.

15. Decision criteria for assigning projects insourced or outsourced should include the need to keep sufficient “interesting” projects insourced to retain a high-quality ODOT technical and managerial workforce.

16. Six interviewees believe that ODOT should provide more guidance to its project delivery consultants both before issuance of the work order contract and during the execution of the contract.

17. Four interviewees indicate that the fact that ODOT’s project delivery consultants are primarily located in large urban areas is problematic for rural areas.

18. Three interviewees believe that projects requiring unusually high numbers of community meetings should be insourced as a means of protecting ODOT’s image.

19. Two interviewees believe that surveying and mapping work is best insourced.

20. Two interviewees express the opinion that high-risk projects, where the risk is controllable by ODOT, should be insourced.

4.4.2 Conclusions

The most significant conclusions drawn from the interviews with ODOT managers are as follows:

1. All ODOT managers interviewed agree that DB delivery has schedule advantages over other delivery methods.

2. All ODOT managers interviewed prefer insourcing projects that have high political sensitivity, that require numerous community meetings, or that are being closely watched by the public.

3. The majority of ODOT managers interviewed have experienced difficulties with outsourcing of ROW acquisition.

4. Projects lacking clear definition present outsourcing challenges using current WOC methods.

5. The majority of ODOT managers interviewed prefer insourcing projects with significant utility coordination issues.

5.0 CONSULTANT INTERVIEW SUMMARY

To supplement the information obtained from the ODOT Area Managers, the research team decided to learn from the pool of engineering consultants operating under ATA (agreement-to-agree) contracts, and to whom work order contracts are awarded to administer PE and CE for ODBB projects. Consultants were chosen as interview candidates because of their obvious role in the outsourcing process. While consultants were expected to be biased toward the outsourcing of projects, they were also expected to have significant insights about the differences in outsourcing efficiency among the project types. Also, consultants were expected to provide great insight into the effect of the various project characteristics on their ability to efficiently design a project and administer the construction contract. ODOT was solicited for a list of major consultants, the majority of whom were interviewed face-to-face.

In April of 2006, ODOT provided a list of contacts for all consultants under contract at that time. In total, ODOT provided ten contact e-mails for nine different firms. During the spring and summer of 2006 the engineering firms were solicited regarding their willingness to participate in interviews addressing the topic of how ODOT delivers outsourced projects. Of the ten contacts one email was never returned and one consultant declined an interview. As a result, eight interviews were conducted with representatives from seven consulting firms. Each individual was asked to participate in a two-hour interview.

These interviews were intended to evaluate the effect of the project delivery method on project performance (budget, schedule, change orders, politics, etc.) and to identify the project characteristics that facilitate outsourcing. Both ODBB and DB project delivery were addressed. These interviews and the interviews with ODOT's Area Managers (see Chapter 4.0) addressed many of the same issues. Although many of the employees of ODOT's project delivery consultants were former ODOT employees, questions were not addressed towards in-house projects.

5.1 INTERVIEW APPROACH

Engineering consultants delivering PE and CE for ODOT were first questioned regarding the interaction between project type and the performance of outsourced projects. Specifically, consultants were asked whether they felt there was a significant difference between the performance of outsourced and in-house delivery for each of the project types. Questions were intended to determine if consultants believed that one type of project is more appropriate for outsourcing than another. Consultants were encouraged to think from the point of view of an ODOT employee and concentrate on the performance of the project in general rather than thinking of performance in their ability to make profit. The ODOT consultants were very cooperative in this process and provided some useful insights. The following remarks represent the collective opinions of the ODOT consultants. Significant disparity in opinion among the consultants will be noted.

5.2 RESULTS BY PROJECT TYPE

The sections of the report that follow will discuss consultant comments related to each of the project types. All consultants strongly believed that, rather than generalizing by project type, it was more appropriate to discuss the outsourcing process by project characteristics. That is, all consultants believed that project type was one of many characteristics that impact the performance of outsourced versus in-house delivery. Evaluating performance based solely upon project type would not be sufficient. Therefore, following the discussion of project types, an additional section will discuss consultant comments on various project characteristics, their interaction with the outsourced delivery process, and their impacts on project performance.

5.3 PRESERVATION PROJECTS

All consultants agreed that ODOT is better structured to deliver preservation projects, because the organization has invested significant time and effort in standardizing the design process. There are several characteristics of preservation projects that make them better suited for ODOT delivery.

Perhaps most compelling is ODOT's relative familiarity with the physical project locations. Past experiences with a physical area (e.g., a stretch of roadway) can have a huge positive impact on the performance of a preservation project. Because of their technical simplicity, most challenges in the design of a preservation project are linked to the unique features of the physical location. Thus, the learning curve required for consultants can have a notable, negative impact on project performance. Also, consultants feel that ODOT has little faith in outsourced design of simple preservation projects, because ODOT has a relatively high familiarity with the project site.

Most consultants (5 of 8) strongly agreed that preservation projects should be kept in house especially when ODOT has familiarity with the project, applicable design standards and guidelines, or when ODOT has the technical capability. Also, it is important to note, consultants often perform small preservation projects primarily as a means to improve relations with ODOT, not to make significant profit. Therefore, preservation projects are not vital to their financial sustainability. Consultants also cited the following reasons why ODOT should consider insourced delivery of preservation projects:

- Frequent but minor policy decisions can change the scope of work and make it very difficult to keep the work order contract constant. Maintaining consistency in the work order contract is essential to consultant performance (8 of 8).

- Projects are typically very small and require travel. It is counterproductive for a consultant to deliver a project where travel overhead significantly impacts project cost and where ODOT offices are relatively close to the site (4 of 8).

- Preservation projects typically have low investment in initial site investigation. This is problematic for consultants because they don't have the budget to do full-site mapping, leading to variation in the work order contract. Conversely, ODOT often has historical site data to use as a foundation for the design (2 of 8).

- Preservation project design is relatively simple (see Complexity Data in Chapter 3.0), making a meaningful profit difficult to realize (7 of 8).

- ODOT can deliver efficiently with state-wide design standards. ODOT is organized better to produce a high volume of similar, simple designs (6 of 8).

- In many cases, consultants spend a significant amount of time learning the specifics of the ODOT system (especially if they are consultants new to working with ODOT). Sizeable learning curves can be especially problematic for simple projects with short design schedules (5 of 8).

Consultants were generally concerned with the overall ODOT strategy for outsourcing more complex preservation projects. The general consensus was that ODOT would benefit from strategically tracking the types of projects they award to specific consulting firms and measuring their performance. When deciding on a consultant, ODOT should review this data and award contracts to consultants that have proven ability to deliver similar projects with similar characteristics. This would reduce the need for a significant learning curve that another consultant had already established. Less time would be wasted from a new consultant's learning curve. If ODOT is going to invest in training consultants and/or paying for a learning curve, all interviewees believed that ODOT should capitalize on their investment.

5.4 BRIDGE PROJECTS

Area managers and consultants all mentioned the same organizational dilemma that ODOT currently faces. Historically, ODOT has had a very competent and capable design staff. Recently, however, a significant portion of ODOT technical staff have left ODOT in favor of employment in the private sector. This phenomenon is especially prevalent for bridge designers. In fact, there are regions in Oregon without any ODOT bridge design staff. Many bridge projects must be outsourced simply because ODOT does not have the technical staff available (and employee sharing between regions is prohibited).

In fact, six of the eight engineering consultants strongly believed that it would take re-staffing and a huge investment on the part of ODOT to match the effectiveness of consultants when delivering bridge projects. According to six of eight consultants, ODOT should invest resources in simply performing due diligence on bridge projects. One respondent strongly believed that, while ODOT cannot deliver most large bridge projects, they are more than capable of delivering small bridge projects (i.e., 75 ft or less).

All consultants believed that bridge projects are the best project type for outsourcing. One should note that consultants made this general statement with the caveat that *not all* bridge projects are appropriate for outsourcing. Much of the project delivery decision should be made by closely examining the project characteristics (presented in Section 5.3).

Consultants cited many reasons why bridge projects are well-suited for outsourcing. The following examples have been highlighted, because they were mentioned by at least half of the consultants interviewed.

- Bridge projects that involve tight schedules and multidisciplinary work are better for outsourcing, if boundaries are well-defined. Consultants are organized to operate efficiently and are often more capable of delivering a project within a tight schedule (7 of 8).

- The OTIA III program is making consultants better at delivering bridges quickly, creatively and effectively. Upon completion of OTIA III, consultants will be well-equipped to deliver bridge projects, and ODOT should capitalize on this experience (5 of 8).

- Bridge projects tend to encompass many disciplines. For example, the design of a bridge may involve the coordination of geotechnical, hydraulic, environmental and structural engineering disciplines. Relative to ODOT, consultants are better at coordinating multiple design disciplines in pursuit of a collective goal (7 of 8).

One consultant, a former ODOT engineer, offered an interesting anecdote about bridge projects. He recalled an experience at ODOT when he had two sets of plans in front of him. One set was for a bridge where the design was completed exclusively by ODOT. The other, which was designed by a consultant, was a nearly identical bridge with identical site characteristics. Despite the similarities between the site conditions and project goals, there was a notable amount of difference between the two plan sets. For example, the bridge deck on the ODOT plans was over twice as thick. Additionally, he made the following observations about the two sets of plans:

- The consultants had covered all of the necessary information in far fewer pages and details.

- ODOT had included extra information that could have been omitted that was a direct product of their standards process.

- ODOT also presented more engineering calculations, but many of them were not necessary.

- Consultant bridge engineers had a tight budget, so they analyzed only the necessary information. The consultant design process was much leaner than ODOT's.

5.5 MODERNIZATION PROJECTS

Unlike bridge and preservation projects, for which consultants were relatively comfortable making general statements about the outsourcing process, consultants believed that modernization projects are so variable that a general statement comparing insourcing and outsourcing on modernization projects cannot be made. Instead, the specific characteristics of modernization projects must be assessed.

Ignoring ODOT organizational strategy (e.g., maintaining a high level of interesting projects, etc.), the best modernization projects for outsourcing are those that are clearly defined with few alternatives. Project definition, possible alternatives, and many other project characteristics will be discussed in the following pages.

5.6 PROJECT CHARACTERISTICS

5.6.1 Schedule sensitivity

Every consultant agreed that the biggest benefit from hiring a consultant is the ability to expedite the schedule. Consultant's customer-oriented strategy and their ability to pool resources allow consultants to produce an acceptable work product in much less time. Therefore, it is advantageous for ODOT to outsource projects that have tight schedules or those that may be fast-tracked. Despite the ability of consultants to complete designs efficiently, their ability is often hindered by ODOT contracting procedures.

Consultants are effective at delivering a project quickly, once the work order contract is developed and ODOT indicates that the design is approved to 'GO'. The problem with outsourcing is getting to 'GO'. Consultants believe that ODOT takes far too long to develop a contract.

Consultants and ODOT view the work order contract through two very different lenses. While ODOT takes time to develop and refine a contract, consultants see this as time when they could be working. Whereas ODOT works to develop a nearly perfect contract to avoid change orders, consultants believe that ODOT should define the contract more quickly and accept change orders as a reality of construction. Consultants have this viewpoint because they frequently manage change orders in the private sector.

5.6.2 Project team complexity

As indicated previously, consultants view themselves as exceptionally proficient in dealing with multiple specialty firms. In fact, during an interview in one office in Portland, OR a meeting was underway in the adjacent room. According to the interviewee, this meeting included representatives from four different firms, each representing a different engineering discipline. These individuals appeared to be working together as if they were all part of the same firm. The interviewee indicated that in many outsourced projects multiple firms work as one team with one cohesive goal. The interviewee's observation is that ODOT cannot achieve such coordination because of internal politics, extensive regulations, and rigid structure. This opinion was shared by six of eight interviewees.

5.6.3 Community involvement and political projects

Community involvement was a very controversial subject. While Area Managers tended to believe that it is in their best interest to control their image, consultants believed that ODOT's image has often been tarnished, and involving a consultant can improve ODOT's image (5 of 8 consultants). Several interviewees indicated that many communities do not have a favorable opinion of ODOT and their intentions. Conversely, consultants are seen as impartial entities with the best interest of the community in mind.

Some consultants believed that ODOT should maintain control over highly visible or political projects; ODOT must be able to effectively present to their communities and regain trust, because, ultimately, they are held responsible for the project and taxpayer dollars. One must remember that if a project performs poorly in the eyes of the community, the consultant can go on to the next project. ODOT, on the other hand, is responsible for the lifecycle of the project. Several consultants believed that complex projects should involve a cooperative effort between consultants and ODOT when presenting to the community (4 of 8). Other consultants (4 of 8) believed that ODOT should always keep the community involvement and political issues in-house. That way, they have control over the risks and can take responsibility for their own work.

Three of eight consultants indicated that community meetings for highly political projects could be handled effectively by consultants when project scope and direction are clearly defined. Problems exist when ODOT and the consultants do not have a firm understanding of the project's direction. Specifically, consultants expressed concern with projects that are in 'limbo,' (i.e., projects that have lost their place or purpose in the overall ODOT strategy).

Four of eight consultants interviewed believed that the best consultants are, by and large, better than ODOT at presenting in community meetings. Because of low quality work in the past, many communities do not trust ODOT's intentions. Consultants typically do not have similar trust or image issues. Instead, consultants have an inherent level of trust with the communities. Communities view consulting firms as entities with a fresh, non-biased outlook. Citizens often assume that the consultant's goal is to deliver the best project possible and that efficient performance follows the consultant's profit and customer oriented strategy. Also, for the most part, consultants are not tied to political motivations but to project performance and professional reputation.

5.6.4 Well-defined work order contract

While consultants had many strong opinions about several topics, no topic was as passionately discussed as the fundamental problems with work order contract definition. According to all consultants, the ability to deliver projects effectively and efficiently is largely dependent on the flexibility in engineering methods, formatting and presentation style, as well as a clear definition of the work product that is expected. Consultants all agreed that the work order contract serves as their guide. Design delivery strategy is centered on this contract and the product that they are expected to deliver. Significant problems arise when ODOT changes, delays finalizing, or includes variable elements (e.g., right-of-way, community meetings, utilities, etc.) in the work order contract.

While there are unforeseen conditions and change orders made on nearly every project, ODOT should not expect consultants to deliver variable elements under a fixed contract. This issue arises more with ODOT than in the private sector, because ODOT allows flexibility in their own schedules for variable elements when delivering insourced projects. That is, ODOT will adjust a schedule or budget once a project has begun if variable elements are different from planned. Where ODOT has flexibility to redefine a schedule or budget to accommodate changes on insourced projects, consultants are tied to fixed estimates in the work order contract for outsourced work. In the eyes of the consultants interviewed, this disparity in accountability often leads to an unfair reduction in profit for consultants and prevents a project from being delivered as efficiently as possible. This statement contradicts the statement that some consultants believed that the work order contract does not necessarily need to be completely defined in order for the consultants to effectively design the project (section 5.3.1). However, the majority of consultants interviewed believed that a well-defined work order contract was essential to effective project delivery on the part of the consultants for all project types. Many of the variable elements and their specific issues are discussed in the following sections.

5.6.5 Railroads/utilities

Railroads and utilities were mentioned by seven of eight consultants as elements of a project that often lead to problems with project delivery. Railroads and utilities are both controlled by firms with objectives that are often independent from the project. Also, there may be little connection between these firms and engineering consultants. Over the years, ODOT has developed a considerable “give and take” type of relationship with these entities. That is, ODOT and railroads and utilities have developed relationships where a project may be expedited by one organization as a favor to the other. Consultants felt that they do not have this type of relationship with railroads or utilities. Instead, they must wait for their project to ‘reach the top of the list.’ To minimize problems with railroad and utility issues, consultants must do a superior job of planning to provide the maximum amount of lead time for dealing with the issues.

Because ODOT has the ability to request priority for a project, most consultants felt that projects with significant utility or railroad influence should be insourced. Three of eight consultants considered the behavior of railroads and utilities to be unpredictable. This makes it difficult for consultants to estimate the cost and schedule duration for interacting with these firms well enough to include in a work order contract. In many cases, consultants estimate a schedule and budget for this task and lose profit when railroads or utilities are uncooperative or require an unusually high number of meetings to resolve an issue. Consultants felt that ODOT should assume responsibility for projects that appear to be highly variable in schedule and budget, because there is much less of a negative impact on ODOT than on the firm if something goes differently than planned.

Two of eight consultants have had a much different experience with DB projects than ODBB projects. DB projects don't have the same problems because they are high profile, and the consulting firm has much more leverage. Utility companies, for example, are much more likely to change their design and/or reschedule meetings to coordinate with consultants on a high profile project than on a less visible project.

5.6.6 Right-of-way (ROW)

Consultants have had a wide variety of experience with the ROW acquisition component of the design process. In fact, some consultants described their ability to deliver ROW as "effective and efficient, often more so than ODOT," while other consultants described their ability as "poor" and the process as "frustrating." Interviews with all eight consultants showed that the factor that separated the firms that noted no problems from those that discussed only problems was obvious. Consultants that reported the best experiences had secured a sub-consultant that employed former ODOT employees. These individuals not only understood the sensitive ROW procedures but were familiar with the acceptable formats for ROW survey work. Understanding what ODOT expects was cited by all consultants as the biggest factor affecting the perceived quality of outsourced ROW acquisition.

Consultants who have had difficulty with ROW acquisition were primarily frustrated with the required format and the extremely high risk associated with the activity. ROW acquisition was described as high-risk because the acquisition process has a high probability of exceeding time estimates defined in the work order contract, and the negative impact on their profit and evaluation of their performance is significant. Despite this risk, consultants recognized the forward progress that has resulted from ODOT's effort to train and inform consultants on ROW acquisition.

In recent years, ODOT has written some very clear guidelines. After some consultants went through a few iterations of the process, acquisition and mapping worked well on projects which followed. ODOT was described as "patient and understanding" during the learning process.

One complaint cited by five of eight consultants is the failure of ODOT to recognize condemnation as an acceptable strategy for delivery of a project. This finding implies a disparity between ODOT strategy and consultant strategy. ODOT will take nearly every measure possible to avoid condemnation and maintain a good relationship with the public. Consulting engineers, on the other hand, will readily use condemnation as a tool for completing the project on time and under budget. The difference, according to the consultants, is the work order contract. Since ODOT is not constrained by such a contract, they are “free to take all the time in the world to please the public. Consultants have to get the project done to meet their obligations.” Some consultants felt that ODOT unfairly views their performance on ROW elements because they inappropriately compare consultant performance to ODOT performance when the consultants are much more tightly constrained by the work order contracts.

Consultants that had difficulty with ROW issues (5 of 8) provided two solutions to the problem: keep the ROW acquisition insourced and outsource the rest of the project or define a more flexible work order contract (e.g., time and materials contract) for ROW acquisition. Consultants with good ROW experiences (3 of 8) preferred that the process stay the same.

5.6.7 Access management strategies and planning

Issues with access management are essentially a composite of those discussed under the ROW and community involvement headings. The public interest element is extremely prevalent and must be handled with extreme care, as access is a very sensitive issue in many communities, especially those with a large business influence. Access management was described by five of eight consultants as very difficult to scope with high levels of political involvement and rigorous, high-intensity community meetings.

Scoping access management tasks can be very difficult due to many elements that are impossible to define at the start of the project. Like ROW acquisition and utility work, access management is problematic because the scope is unclear, typically until after the work order contract has been defined. Community members, especially business owners, are often highly concerned when access is restricted.

The access management component of projects may be better delivered by ODOT, especially if the scope of this project element cannot be well-defined from the beginning, or if ODOT has previous experience with the project stakeholders. Community involvement due to poor access management planning or upset community members and business owners can deter the consultant’s work and introduces an unfair risk that must be absorbed by the consultant via the fixed price work order contract.

5.7 OTHER VIEWS EXPRESSED BY CONSULTANTS

The following comments were provided and verified by less than half of the consultants, but they are worth considering. These comments from a minority of consultants likely result from the wide range in size and variety of technical expertise of consultants interviewed. The problems or suggestions made by consultants were ultimately linked to the loss of flexibility from the contracting process.

- Traffic signals are better delivered by ODOT because they have excellent employees and experience in this area. In comparison to the consultants, ODOT is far more advanced. In fact, consultants would have to ask for ODOT assistance for this discipline in most cases. Therefore, ODOT should keep this in-house as much as possible. It also keeps ODOT as the authority in one discipline (2 of 8).

- ODOT needs to focus on insourcing their strengths and outsourcing their weaknesses. By concentrating their resources, ODOT may be capable of delivering more projects in less time and under budget. Rather than competing, ODOT would be better off working cooperatively with consultants. This involves using the consultants' strengths (time, efficiency, ability to organize complex teams, etc) on complex projects or those with tight schedules and keeping projects that involve signals, signage, pavement design, survey and ROW acquisition insourced (3 of 8).

- ODOT has an advantage in that they can train their employees more effectively. Consultants believe they have more schedule pressure and do not feel that they can afford (money and time) to send their employees to be trained by ODOT. Consultants have to be selective in what training programs they send their employees to. Therefore, small consulting firms cannot be well-trained in ODOT formatting in every area (1 of 8).

5.8 SUMMARY OF INTERVIEWS OF ODOT'S PROJECT DELIVERY CONSULTANTS

5.8.1 Summary of findings

The findings from analysis of the information obtained from the interviews with the engineering consulting firms contracted by ODOT for project delivery (PE and CE) are summarized below:

1. Consultants believed that project characteristics such as schedule sensitivity, project team complexity, community involvement, degree of project definition, presence of utility work or railroad work, presence of right-of-way issues, or presence of access management issues, are more important in the decision to outsource or insource than is the identification of the project as bridge, modernization, or preservation.

2. Five of eight project delivery consultants believed that preservation projects should be insourced.

3. The best modernization projects for outsourcing are projects that are clearly defined.

4. Many bridge projects must be outsourced because ODOT does not have enough internal resources.

5. ODOT's OTIA III program is improving the ability of ODOT's project delivery consultants to deliver bridges quickly, creatively, and effectively.

6. Many consultants believed that ODOT should do a better job of tracking performance of consulting firms by type of project so that more optimal assignment of future outsourced projects may be made.

7. There was unanimous agreement among the consultants interviewed that the biggest benefit of outsourcing is the ability to expedite schedule.

8. Consultants believed that the time required to agree to the work order contract can and should be reduced.

9. Consultants believed that they can do a better job than ODOT of delivering projects with large numbers of technical specialties.

10. Five of eight consultants interviewed believed that the best consulting firms can do a better job than ODOT in managing community involvement and community meetings. There are strong dissenting opinions. ODOT AMs also disagreed with the majority of consultants on this issue.

11. All consultant representatives interviewed agreed that ODOT should not expect consultants to deliver poorly defined projects with high potential variability in required effort under a fixed-price work order contract.

12. The majority of consultants believed that ODOT's insourced projects are not held to the same standards for budget adherence and on-time delivery, as is expected of the consultants on outsourced work.

13. Seven of eight consultant interviewees identified projects with railroad work or utility work as projects that lead to project delivery problems.

14. The majority of consultant interviewees believed that projects with significant utility or railroad influence should be insourced because of the impossibility of accurately estimating engineering effort required to deal with the unpredictability and independence of railroads and utilities.

15. Consultants believed that railroads and utilities are more easily managed on a high-profile project than on more routine projects.

16. Consultants' experiences with right-of-way acquisition varied widely from a feeling that consultants can do it better than ODOT to feelings that ODOT should not outsource ROW acquisition.

17. Consultants with the best ROW acquisition experience had secured a sub-consultant staffed with former ODOT employees.

18. Because of the rigidity of the work order contract, consultants are more likely to accomplish ROW acquisition by condemnation than is ODOT, which has more schedule flexibility on insourced projects.

19. Four consultants that were dissatisfied with ROW acquisition procedures recommended either:

    a. retaining ROW acquisition insourced on an otherwise outsourced project or,
    b. defining a more flexible work order contract, possibly on a time and materials basis.

20. Projects with significant access management issues face the same outsourcing challenges as projects with significant community involvement, railroad or utility work, or ROW acquisition issues.

5.8.2 Conclusions

The most significant conclusions drawn from the interviews with the engineering consulting firms that ODOT uses to outsource preliminary engineering and construction engineering are as follows:

1. Expediting schedule is a major benefit of outsourcing project delivery.

2. A common theme among all consultants is the difficulty associated with the work order contract and managing uncontrollable risk. Consultants generally agree that elements that prevent the project design from staying within budget or schedule cause consultants to compromise other project elements or lose profit. Therefore, scope elements with high variability can often lead to a reduction in quality, poor schedule performance or a loss of profit. Consultants feel it is unfair to be required to sign work order contracts that include elements that are difficult or impossible to define, especially when change orders are difficult and when ODOT does not have the same limitations on insourced projects. Consultants believe that a more flexible WOC would speed time to contract and assign risk more equitably.

3. Consultants agree with the AMs that projects with ROW acquisition, railroad or utility interface present challenges. Consultants believe that the nature of ODOT's current WOC makes these challenges difficult for consultants to manage.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions are presented under subheadings for ODOT Data Maintenance, IDBB or ODBB Assignment by Project Type, and Other Conclusions. Many of these conclusions repeat those presented in the last sections of Chapters 3, 4, and 5 or are combined from them. These chapters summarized respectively the data analyses, the ODOT Area Manager interviews, and the interviews with ODOT's project delivery engineering consultants. Overall recommendations based on the conclusions are presented in Section 6.4.

6.1 ODOT DATA MAINTENANCE

The challenges faced in obtaining valid project performance data were discussed in Chapter 2. Results of the analyses of project data discussed in Chapter 3 provide further information on the difficulty of obtaining quality data. Based on this information, the following conclusion is warranted.

1. The use of project delivery performance metrics adapted from benchmarking measures used by the Construction Industry Institute (CII), while conceptually reasonable, proved difficult to apply because of the following factors:

    a. A practical way to define the start of the project, agreeable to all TAC members, could not be found. The principal investigator used the date of establishment of an EA (expenditure account) as the start date. Whether work actually commenced at that time or not was not known.

    b. ODOT defines the start of project delivery as the time that a project is placed in the STIP. The STIP sets a target year for the project to be "let" and for funds to be committed. No construction duration or end date is specified at the time the project is placed in the STIP. Consequently, at the time project delivery begins, there is no target end date for the project. While this is consistent with established DOT procedures, it presented challenges for measuring overall schedule performance from authorization to project completion.

    c. The practice of splitting and combining OTIA I & II projects made tracking budget and schedule performance difficult for split and combined projects. It should be noted that projects were split and/or combined with other projects to obtain efficiencies in project design, construction, and administration. Thus the splits and combines were beneficial to the projects, but unfortunately they dramatically reduced the number of usable projects available for performance data analysis.

d. “Current estimates” were not always kept current, resulting in “current estimate” values less than “current expenditures” in some cases.

e. Green-Yellow-Red reports sometimes showed different budgets and schedules than the values in the OTIA I & II database supplied by the ODOT Office of Project Delivery.

6.2 IDBB OR ODBB BY PROJECT TYPE

Table 6.1 presents a summary of conclusions from Chapters 3, 4, and 5 which favor assignment of bridge, modernization, and preservation projects to IDBB or ODBB delivery. Table 6.1 is Table 3.8 updated to include the opinions of ODOT AMs and ODOT’s project delivery (PD) consultants.

Table 6.1: Insource/outsource preferences for PE and CE based on statistical analyses

	PE	Non-Specific to PE or CE	CE
Bridge	O – GC ratings – completeness of design O – GC ratings - constructability	O – AM interviews O- Project delivery consultant interviews	
Modernization		O – Construction Schedule Growth I – Construction Budget Growth I – Total Budget Growth	I– %CE
Preservation	I – %PE I - % change order $	I – Total Budget Growth I – Consultant interviews	I - %CE

I = Insourced-Design-Bid-Build preference
O = Outsourced-Design-Bid-Build preference

The following conclusions may be drawn from Table 6.1 and other findings:

1. Bridge projects are well-suited for outsourcing because they are typically easy to define, highly technical, require the coordination of multiple engineering disciplines, and ODOT currently lacks adequate staff to perform the work.

   a. Supported by: AM and PD Consultant interviews, and analysis of construction contractor database of subjective project ratings. In addition, ODBB bridge projects have been more complex than IDBB bridge projects (see #4 below)
   b. Neutral: Analysis of the Area Manager database of subjective project ratings and analysis of the OTIA I and II database showed no statistically significant differences of means between insourced and outsourced bridge projects.
   c. Refuted by: None

2. Preservation projects are usually better delivered insourced because they are typically difficult to define in the work order contracts, are not as attractive to consultants, and are in line with ODOT’s current internal capabilities.

   a. Supported by: Change order database analysis, PE costs, CE costs, total budget growth in the OTIA database, and PD Consultant interviews.
   b. Neutral: None
   c. Refuted by: None

3. Outsourcing decisions for modernization projects should be made on a project-by-project basis, dependent on specific project characteristics. Modernization projects may be effectively delivered IDBB, ODBB, or DB.

   a. Supported by: Consultant interviews (6/8 of respondents); and analysis of Area Manager (AM) database of subjective project performance ratings shows no statistically significant difference of means between IDBB and ODBB modernization projects.
   b. Neutral: Analysis of database shows mild preference for insourced IDBB delivery based on construction budget growth, total budget growth, and %CE; only construction schedule growth favors ODBB delivery. The mild preference for insourcing has resulted even though assigned IDBB modernization projects have been more complex (see # 6 below).
   c. Refuted by: None

4. The ratings by ODOT Area Managers of the complexity of insourced and outsourced bridge projects indicated that the insourced projects were less complex than the outsourced projects.

5. The ratings by ODOT AMs of the complexity of insourced and outsourced preservation projects showed no statistically significant difference.

6. The ratings by ODOT AMs of the complexity of insourced and outsourced modernization projects indicated that the insourced projects were more complex than the outsourced projects.

7. Five of eight project delivery consulting engineers interviewed believe that preservation projects should be insourced.

8. Eight of eight PD consultants believe that bridge projects are the best for outsourcing.

6.3 OTHER CONCLUSIONS

Other conclusions from the research include the following:

1. Twelve of twelve ODOT Manager interviewees agreed that DB delivery has advantages for projects that must be delivered on an aggressive schedule.

2. The collective recommendation from the interviews is that if schedule sensitivity is normal, IDBB or ODBB project delivery is preferred over DB.

3. Subjective ratings by ODOT Area Managers of 186 projects showed no statistically significant differences in performance for modernization or for bridge projects delivered IDBB and ODBB. There were no ODBB preservation projects in the AM rating database, so no comparison with IDBB preservation projects could be made.

4. Decentralization of technical services & barriers to combining technical resources from different Regions tends to drive projects toward outsourced project delivery.

5. Outsourcing right-of-way acquisition increases the likelihood of condemnation because of schedule pressures not present on insourced projects.

6. Seven of ten AM's have experienced difficulties related to outsourcing ROW acquisition. ODOT's PD consultant views of ROW acquisition varied widely. Opinions range from the view that ODOT should keep this task insourced to the view that consultants can do it better. There is room for improvement in ODOT's procedures for handling ROW acquisition on outsourced projects.

7. Eight of twelve ODOT interviewees favor insourced delivery of PE of projects with significant utility coordination.

8. Twelve of twelve ODOT interviewees favor insourced delivery of politically sensitive projects because of longer term relationships between local ODOT offices and the public.

9. Seven of seven ODOT interviewees who addressed the topic of assigning projects that are not clearly defined preferred their assignment to IDBB delivery.

10. ODOT management interviewees expressed the opinion that retention of some work insourced is needed to retain technical expertise. For example, four of ten interviewees believe that ODOT must retain some bridge projects insourced to maintain bridge design expertise. This is consistent with findings of an FHWA Federal Lands Highway Division study (*Calderon, et al. 2000*). That study warned against outsourcing more than 80% of the work in a specific discipline.

11. Eight of eight PD consultants believe that the ability to expedite schedule is the greatest benefit to be gained by outsourcing PD.

12. Seven of eight PD consultants believe that they do not enjoy the same priority with railroads and public utilities as does ODOT. Eight of 12 ODOT management interviewees also believe that ODOT has more influence on utilities than do individual engineering consulting firms. Consequently, projects with significant railroad or public utility interfaces may be best insourced.

13. Eight of eight PD consultants believe ODOT should change its approach to work order contracts. ODOT should either accept change orders on projects with highly variable scope, or pay for developing variable scope into firm scope on a time and materials contract.

14. ODOT AMs and ODOT's project delivery consultants agree that projects with poorly defined scope with potentially highly variable effort present challenges for the current ODOT work order contracting procedures. Projects with high levels of public meetings, access management, ROW acquisition, or utility work are projects of this type. Fixed scope/fixed price work orders for these types of projects may lead to consultants assuming excessive risk, or ODOT paying consultants to assume risk that might be better kept with ODOT.

15. For projects with high uncertainty, time and materials work orders could be an option. Use of contingency tasks could be an option. Insourcing such work is another option.

16. As would be expected, there are areas where there are significant differences of opinion between ODOT managers (Chapter 4) and ODOT's project delivery consultants (Chapter 5). Of these issues, the relative ability to work in complex design teams, the ability to conduct public meetings and deal with the public, and the ability to perform ROW acquisition showed the most disagreement. ODOT mangers generally thought these function can best be done insourced. Consultants thought that in many cases, they are better equipped, or can become better equipped, to perform these functions.

6.4 RECOMMENDATIONS

Based on the analysis of information and conclusions reached, the following recommendations are made.

1. ODOT should consider changes in its procedures for authorizing projects, reporting data, and establishing cost & schedule performance criteria. Having a total project budget expectation and a target project end date could provide better accountability and control and would also enhance the appearance of a credible process. For over 20 years, the members of CII have invested heavily in developing practices for efficient delivery of projects. In addition, they have developed extensive benchmarking procedures in order that their member companies may track project delivery performance and compare their performance to the other members of CII. The members of CII generally set measurable budget and schedule goals at the time projects are authorized, and measure performance against them. There may be reasons why DOTs need to follow different procedures than the major industrial and federal government owner, designer, and constructor members of CII, but the CII standards should be considered. Alternatively, it may be more appropriate for DOTs through AASHTO or some other mechanism, to develop uniform performance measures and share their results in a benchmarking forum.

2. ODOT should review its work order contracting procedures for dealing with projects with potentially high variability in required effort. Projects with significant access management, public meeting, utility, and ROW issues frequently fall into this category. Alternatives to be explored include not outsourcing such work, paying for

3. The relatively small number of outsourced projects in all of the database subsets obtained made establishment of statistical significance at any meaningful level difficult. Because ODOT's experience with IDBB and ODBB began with OTIA I and II, and ODOT's experience with DB began in 1998, significant numbers of outsourced projects have not been available. By 2009 the number of completed outsourced projects should be large enough for meaningful analyses. At that time, ODOT should repeat the analyses of this report with the larger databases that will be available. This recommendation is contingent upon continuing improvements in data reporting. If the data available are no better than what were available for the current study, this effort would not be likely to be fruitful.

4. The project-by-project ratings obtained from ODOT's construction contractors of the quality of PS&E documents and of construction contract administration (see Figure 3.1) is potentially useful information for all projects. ODOT should make obtaining such ratings a part of standard project close-out procedures. Combined with evaluations from ODOT personnel, this information should be used for selection of PD consultants for future projects.

5. As was discussed in the chapters on ODOT Area Manager interviews and PD consultant interviews, it is recommended that the final insource/outsource decision be made on a project by project basis, considering individual project characteristics such as requirements for community involvement, access management, ROW acquisition, and railroad or utility issues, rather than on project type. This is particularly true for modernization projects.

6. When outsourcing is necessary, bridge projects should generally be the first projects outsourced.

7. Preservation projects should be retained insourced whenever possible.

8. The decision tree of Figure 6.1 below suggests guidelines for designating projects for DB, IDBB, and ODBB delivery. The interviews with ODOT's AMs and ODOT's PD consultants, combined with statistically significant findings from the analyses of the database, were used as the basis for development of this decision tree.

   The preponderance of information from the literature review presented in the interim report (*Rogge, et al. 2003*) indicates that for a given size of DOT project delivery organization, the cost of outsourced project delivery will be greater than the cost of insourced project delivery. Consequently, the decision tree favors insourcing until ODOT's capacity to deliver projects is reached, at which time projects must be outsourced. In addition, where attainment of aggressive schedule goals is paramount for project success, design-build delivery should be considered.

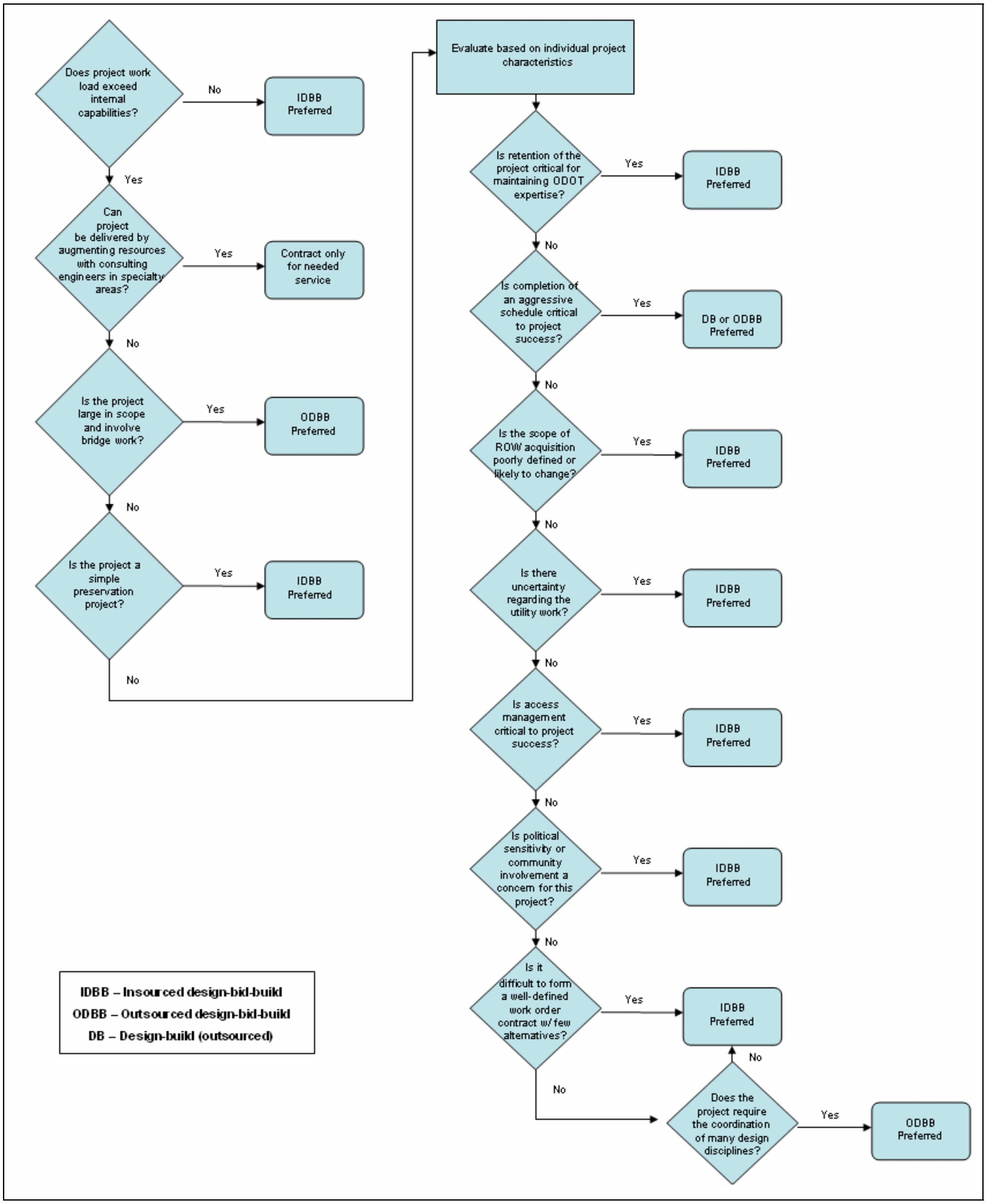

Figure 6.1: Decision Tree for insource/outsource decision

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