Assessing the Costs Attributed to Project Delays

0-6581

Texas Transportation Institute

The Texas A&M University System
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EXECUTIVE SUMMARY

All departments of transportation (DOTs) face delays on highway projects. They often have anecdotal accounts of the significant financial impact that the delay of a highway project had on project costs, local businesses and commuters, and other users of the highway. But in many cases hard data on the financial impact are lacking. This project for the Texas Department of Transportation (TxDOT) aims to develop a simple but sound methodology for estimating the cost of delaying most types of highway projects. The project draws on two main resources to produce reliable estimates of impacts:

- Existing data from projects completed in fiscal year (FY) 2009 and reported in TxDOT's Design Construction Information System (DCIS).
- Methodologies developed for other applications that can be applied to estimating the cost of project delay.

Delay during Project Phases

Delay can occur in any phase in the project:

- **Planning/scoping phase:** Delay can be significant when litigation is initiated.
- **Development phase:** Permitting (environmental, fish and wildlife, railroad, etc.), right-of-way acquisition, and utility agreements can be significant causes of delay.
- **Contracting phase:** Generally, this phase has less incidence of delay but can still have issues.
- **Construction phase:** This phase has numerous opportunities for delay and is often the delay most visible to the public.

Project delay almost always has costs associated with it, which is not to say that all project delay is a waste of time and public money. In many instances of project delay initiated by TxDOT, the reason for the delay is to make an improvement in the design or construction of the project that will ultimately deliver better value to the public.

Estimation Model

This project developed a simplified model that incorporates 16 user-controlled variables and produces estimates of the effect of project delay on personal and commercial travel and the cost to the general economy. Three projects of varying size were used as examples:

- The "small project" illustrates delay to an $11.4 million, four-lane roadway project in a rural setting. The project's 33-month delay produced an additional $3.5 million cost to the economy, or *$96,000 for every month of delay.*
- The "medium project" illustrates delay to a $49.6 million, urban freeway project. The project's 58-month delay produced an additional $17.8 million cost to the economy, or almost *$300,000 for every month of delay.*
- The "large project" illustrates delay to an $82.2 million interstate highway improvement in a large metro area. The project's 11-month delay produced an additional $5.1 million cost to the economy, or *$447,000 for each month of delay.*

Case Studies

Finally, the report includes three atypical case studies that demonstrate a range of delay issues, all with costs attached including litigation costs and termination fees paid to contractors. These costs are in addition to the types of costs calculated in the model discussed above.

PURPOSE AND SCOPE OF THE REPORT

This report helps identify the costs of delays to completing roadway projects, and a methodology for estimating those additional costs to the state and to users. The report also addresses three basic elements related to project delay:

- Definitions and types of project delay.
- Methodology for estimating project-specific delay costs.
- Case studies that demonstrate the application of the methodology.

For this report, the Texas Transportation Institute (TTI) examined recent TxDOT projects that meet the following requirements:

- Construction projects (e.g., new construction, reconstruction, and rehabilitation).
- Projects that had sufficient data requirements in order to be analyzed (e.g., projects in metropolitan planning organization [MPO] jurisdictions with readily available travel demand data).

The following types of transportation projects were excluded from this analysis:

- Projects that experienced delays due to lack of funding.
- Transportation projects with a total project investment of less than $7 million.
- Maintenance projects.

In most cases examined in this study, delay occurred because the project missed a milestone according to the project schedule dates established by the project engineer and the respective TxDOT district. This study did not examine the scheduling process that occurs during the planning/scoping phase of the project life cycle to see if that aspect of a project (i.e., overly optimistic schedules) might be an inherent source of delay.

TERMINOLOGY

The following glossary defines certain terms and phrases used within this report. It also clarifies what is and is not included in the various types of costs associated with project delays. Appendix A contains a list of acronyms used in this document.

Direct Costs of Project Delay—actual out-of-pocket costs borne by any stakeholder affected by a delay in project delivery. Most of the direct costs accrue to TxDOT and, therefore, are passed on to the public in the form of less-efficient use of taxpayer resources.

Indirect Costs of Project Delay—hidden costs that are borne by stakeholders, often a much greater amount than the direct costs of project delay. Indirect costs include:

- Wasted traveler fuel and time.
- Economic impacts in the vicinity of the project.
- Loss of business efficiency for those businesses that rely on the transportation system for their productivity.

Project Delay—In estimating the difference in planned and actual project completion date, this report assumes that the *planned* completion date is the date from the notice to proceed plus the number of days allowed for construction. The *actual* completion date is when the project is open for public use.

Project Stages—usually divided into four distinct stages: planning, development, contracting, and construction. Delays that occur during the various stages typically affect different stakeholders (e.g., the state, contractors, businesses, or the public) in different ways. Once a project has been identified, its life cycle includes defined stages and milestones. Figure 1 illustrates the general project stages, basic activities that occur in each stage, and some of the major milestones.

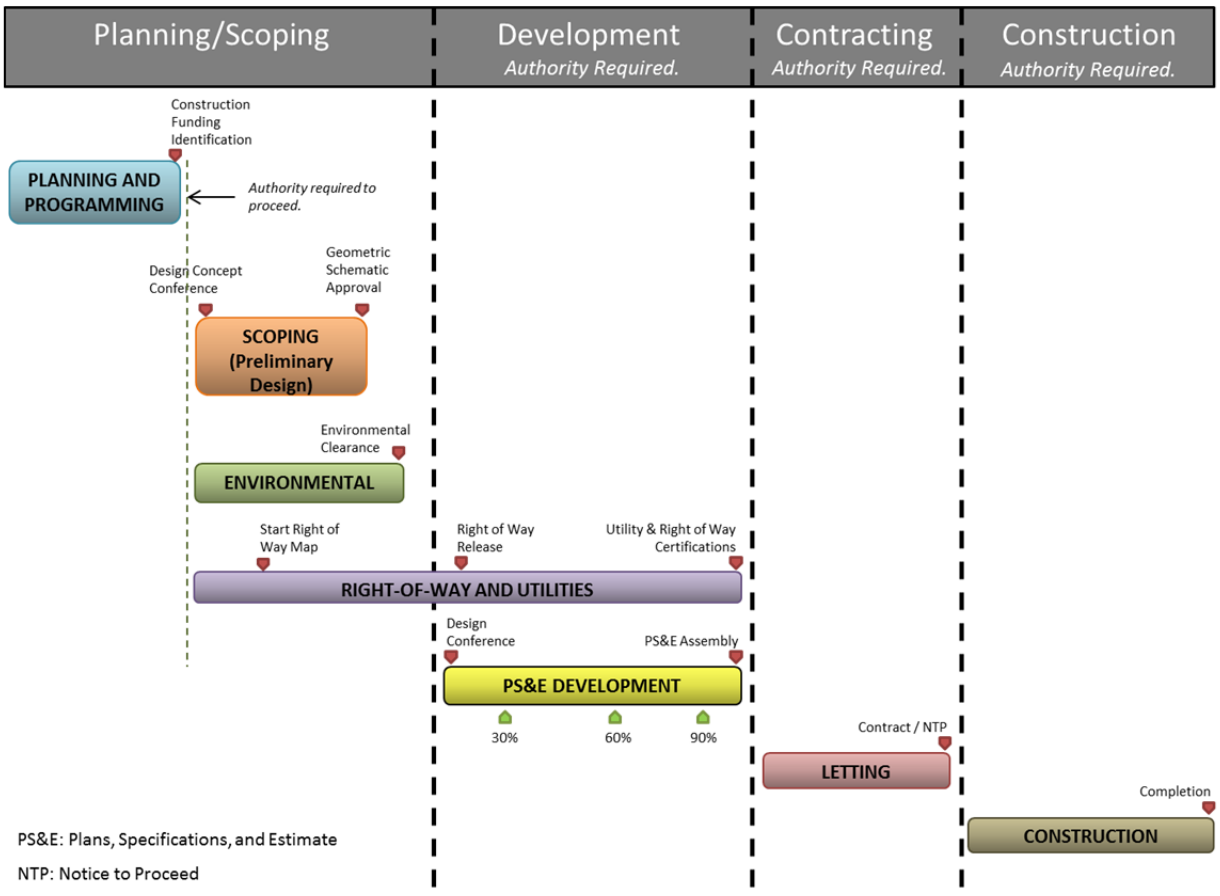

Figure 1. Life Cycle of a Typical Roadway Project.[1]

[1] C.A. Quiroga, E. Kraus, J.H. Overman, and N.A. Koncz. *Integration of Utility and Environmental Activities in the Project Development Process.* Report 0-6065-1, Texas Transportation Institute, http://tti.tamu.edu/documents/0-6065-1.pdf.

WHO BEARS THE COST OF PROJECT DELAY?

Ultimately, the public bears the cost of project delay.

Three major groups of stakeholders are affected by project delay:

- The agency.
- The public.
- Contractors (and their suppliers).

Figure 2 provides a conceptual schematic diagram of how direct and indirect costs at various stages of the project timeline can affect these stakeholders.

The costs of project delays can be classified as either direct or indirect costs to the public, the agency, or contractors. Some costs to the agency or contractors associated with contract delay are recoverable by the entity incurring the cost; others are not. As shown in Figure 2, ultimately, all costs are eventually borne by the public.

Direct costs are divided into three categories:

1. **Agency costs.** The cost cited in Figure 2 is the expense associated with additional engineering services. These costs may or may not be recoverable. In some cases, the agency can recover the costs if they are due to errors by others. If the costs are not recoverable, the expense becomes an indirect cost that is ultimately paid by the public.
2. **The cost in extra fuel and time wasted by the public because of project delay.** The public is not reimbursed for that cost.
3. **Contractor costs.** The contractor absorbs costs due to unproductive labor (e.g., the contractor is told by the agency or some other authority to cease construction or has to, for some other reason, pay labor costs on a standby basis). The agency may reimburse the contractor. But for the agency, the cost is likely not reimbursable and is ultimately borne by the public. If the cost is not reimbursable to the contractor directly, it becomes an indirect cost to the contractor that is ultimately transferred to the agency or the public in some other form (e.g., higher contract prices in the future).

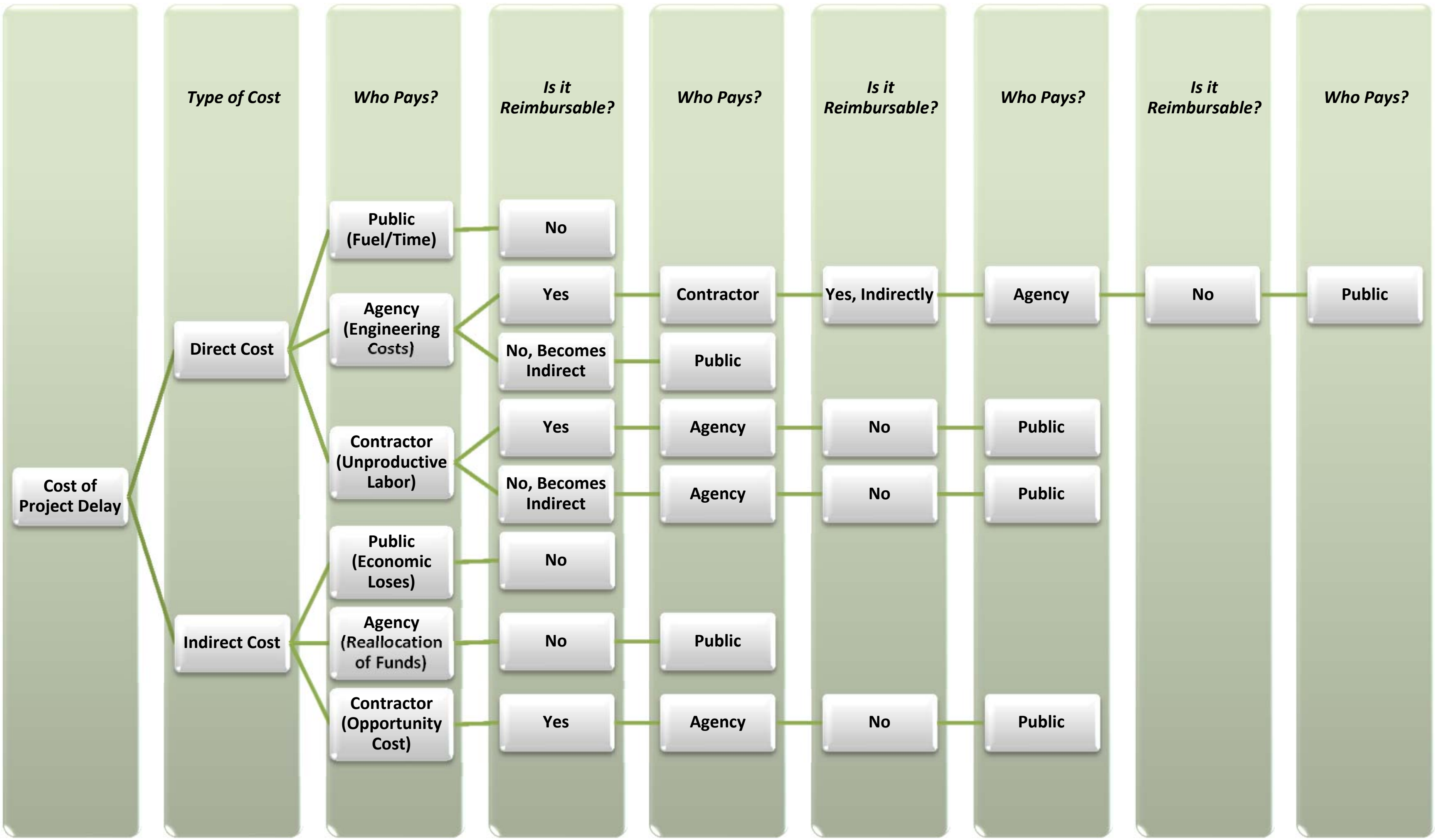

Figure 2. Stakeholder Impacts of Direct and Indirect Project Costs.

Costs to the Public

Direct and indirect costs paid initially by the agency are ultimately borne by the public. For example, when a project is delayed early in the process, engineering, right-of-way, material, labor, or other cost elements may increase because of the delay. This is a direct cost of project delay that is ultimately paid by the public.

Additionally, because TxDOT has a finite supply of funds with which to operate in a given year, the increased costs will likely mean that other previously scheduled and budgeted projects will have to be postponed and their benefits delayed. These are considered indirect costs to the public.

Costs to Travelers in the Affected Corridor

Two of the most recognized costs to the public are associated with wasted time and fuel cost. We all place a value on our time. When a project is delayed and improvements to the particular corridor postponed, the benefits associated with that improvement (e.g., higher speeds and shorter commute times) are not realized. Furthermore, with the slower commute speeds, fuel efficiency may be reduced, resulting in higher fuel costs for travelers.

Costs to Businesses and Their Consumers

One of the most important cost aspects of project delay is the impact on businesses and consumers. Businesses are affected by roadway congestion in much the same way as motorists. As speeds are reduced, operating costs (i.e., driver time, vehicle operating costs, fuel costs, etc.) are increased. Ultimately, these costs are passed on to the consumer. But there can be other, more pervasive impacts as well.

Almost all surveys that ask businesses about factors that influence location decisions show similar results. They indicate that businesses most value the following when deciding where to locate a facility:

- A fair and reasonable tax system.
- An educated and available workforce.
- Access to markets.

Reduced mobility affects businesses in two ways: it reduces the supply of qualified workers who live within a reasonable commute distance, and it increases the cost of accessing markets, causing increased shipping costs for both raw materials and finished products.

With respect to labor markets, as mobility is reduced and commute times lengthen, the labor pool within a one-hour commute to a particular location is reduced. To attract a wider number of potential employees, some companies may find it necessary to offer higher wages to offset the higher costs of commuting. If they do, those higher wages are potentially reflected in higher finished product cost, hindering the company's ability to compete in a market. If the costs of higher wages are not reflected in higher product costs, then income to the company's shareholders is reduced.

Similarly, reduced mobility affects the cost of finished goods when fuel cost, driver time, and vehicle-operating costs are increased because of lower speeds on the roadways.

Costs to Contractors

Contractor costs also increase because of project delay. If a project is delayed after a contractor has mobilized a workforce and obtained equipment, consumables, and other materials, the contractor must often absorb those costs. This reduces income to the company and to its shareholders. To the extent that those costs are recoverable, they are passed on to consumers during a subsequent project.

In addition, the uncertainty associated with project delays can impede a contractor from bidding on other projects. These lost opportunities can reduce competition, which may result in higher construction bids on other projects.

Conclusion

With few exceptions, the public ultimately bears the cost of delays—traveler costs, added transportation costs in retail products, loss of business efficiency (resulting in higher costs and lower profits), and fewer public (TxDOT) dollars available to spend on a variety of project needs.

SAMPLE METHODOLOGY FOR ESTIMATING COST IMPACTS OF PROJECT DELAY

Types of Example Projects

Table 1 shows three different example projects:

- "Small projects" range in cost from $7 million to $20 million.
- "Medium projects" range in cost from $20 million to $80 million.
- "Large projects" cost more than $80 million.

The small project illustrates the costs associated with a four-lane roadway in a rural setting. In this example, the roadway is a 2.7-mile-long widening project on FM 1488 in the Houston District. The project stretched from just east of SH 242 to just west of IH 45. The two-lane roadway was widened to a four-lane divided roadway. The project began in March 2009 after 33.5 months of delay. The cost associated with this delay is estimated at $96,000 per month, or a total of more than $3.5 million.

The medium project depicts the cost associated with an urban freeway project, in this instance a 2.6-mile-long widening project on US 59 in the Houston District. The project segment stretched north of FM 1314 to just north of Northpark Drive. The freeway was widened to consist of eight main lanes with two three-lane frontage roads. After almost five years of delay, the project began in August 2002. The estimated cost of delay per month was $297,000 per month, or a total of $17.8 million over the entire delay period.

The final example is the large project, showing costs associated with an interstate project in a large metro area—an interchange reconstruction project at IH 10 and IH 410 in the San Antonio District. The 1.5-mile-long project was from south of Callaghan Road to south of North Crossroads. This project began in July 2002 and experienced an 11-month delay during construction. The cost of delay per month was an estimated $447,000 per month, or $5.1 million for the entire 11-month period.

Table 1. Sample Costs to the Public Resulting from Project Delays.

Estimated Cost of Project Delay			
Project Description			
Project-Related Variables			
	Small Project	**Medium Project**	**Large Project**
Project Cost (Millions)	$11.4	$49.6	$82.2
Total Months Project Was Delayed	33.5	58.8	11.1
Change in Highway Cost Index (HCI) (during Delay)	11%	29%	3%
Travel-Related Variables			
Length of Project	2.7	2.6	1.5
Average Daily Traffic—Before Improvement	21,000	91,000	158,000
Average Daily Traffic—After Improvement	26,000	99,000	196,000
Travel Speed—Before Improvement	46	58	59
Travel Speed—After Improvement	50	60	61
Percent Trucks—Before Improvement	4.5%	10.0%	3.9%
Percent Trucks—After Improvement	4.5%	10.5%	3.9%
Commonly Used Assumptions			
Persons per Vehicle	1.25	1.25	1.25
Value of Time—Cars	$16.28	$16.28	$16.28
Value of Time—Trucks	$107.42	$107.42	$107.42
Cost of Fuel—Cars	$3.78	$3.78	$3.78
Cost of Fuel—Trucks	$3.95	$3.95	$3.95
Return on Investment Associated with Economic Impacts	8.0%	8.0%	8.0%
Monthly Cost of Project Delay			
Wasted Time from Project Delay—Personal	$26,363	$31,248	$63,902
Wasted Fuel from Project Delay—Personal	$19,260	$8,510	$7,421
Wasted Time from Project Delay—Commercial	$6,557	$18,410	$13,689
Wasted Fuel from Project Delay—Commercial	$1,094	$3,334	$1,413
Total Direct Cost to Travelers	**$52,180**	**$58,167**	**$85,012**
Construction Cost Increase per Month (based on HCI)	$32,957	$191,956	$283,624
Sub-total, Direct Costs	**$85,137**	**$250,123**	**$368,636**
Economic Impact of Project Delay	$10,841	$47,170	$78,172
Total Cost of Project Delay *per Month*	**$95,978**	**$297,293**	**$446,808**
Total Cost of Project Delay	**$3,551,431**	**$17,764,387**	**$5,127,080**

Discussion of Medium Project Example

Using the medium project as an example illustrates how project delays can ultimately cost the public. In this example, a $49.6 million project was delayed a total of 58.8 months. The following conditions on the roadway were present:

- 91,000 vehicles in average daily traffic.
- Commercial trucks making up 10 percent of vehicles.
- 1.25 persons per automobile.
- 58 miles per hour average speed before the improvements.
- 60 miles per hour average speed after the improvements.
- a 29 percent increase in the price of construction during the time the project was delayed.[2]

The medium project, as shown in Table 1, demonstrates that when applying standard values of time for both individuals and commercial vehicles—and assuming a conservative 8 percent return on investment in roadway infrastructure[3] (national studies indicate the return is more likely in the 10 to 12 percent range)—the 58.8-month delay had a total cost of $17.8 million, or almost $300,000 per month.

Of that cost, slightly over $250,000 per month was the result of construction price increases estimated by using the HCI. Almost all of this increase resulted from the significant increases in commodity prices (e.g., cement, base material, steel, asphalt, and fuel) experienced during the period. Almost $50,000 per month was the result of delays in commuter and business delivery times, while almost $12,000 per month was the result of increased fuel costs associated with higher consumption at slower speeds. Finally, almost $50,000 per month was associated with the economic impact of delay.

The expansion of the roadway allowed substantially more throughput, though only modest changes in speed. Because of the induced demand associated with expanded roadways, speeds can actually stay the same or slightly decrease as more vehicles use the freeway. When that occurs, vehicles are drawn to the new/expanded facility from other highways and/or arterial streets, thereby improving travel times, reducing wasted fuel, and generating a positive economic effect on those particular roadways. In general, however, the magnitude of the impact of project delay depends on traffic volume and speed, percent trucks, spikes in construction costs, and duration of delay.

Also, because of the number of variables involved (and their relative importance depending upon roadway location, roadway type, availability of transportation alternatives, traffic mix, cost of materials, etc.), in almost every instance where a project is delayed, the cost of delay can vary significantly. As a result, every instance of construction delay, even on roadways that appear to be similar in nature, can result in a different cost of delay estimate. See Appendix B for a description of the variables and methodology used for the cost calculations.

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[2] Project inflation calculations taken from the Highway Cost Index produced by the Texas Department of Transportation (http://ftp.dot.state.tx.us/pub/txdot-info/cst/hci_binder.pdf).

[3] M. Ishaq Nadiri and Theofanis P. Mamuneas. "Contribution of Highway Capital to Output and Productivity Growth in the US Economy and Industries." http://www.fhwa.dot.gov/policy/gro98cvr.htm.

SUMMARY

This brief research project examined the costs that result when a roadway project is delayed. It examined both direct and indirect impacts of project delays and found that the public almost always bears the costs, either directly through wasted fuel and time or indirectly through less-efficient use of the limited supply of roadway funds. This project did not directly examine the *value* of any of the delays, though it was evident while examining the data that many delays actually produced benefits that equaled or exceeded the *cost* of the delay.

The simple methodology developed in this project allows TxDOT to quickly estimate the cost of delay to a roadway project. Using that methodology, researchers examined three actual projects. The smallest of the three resulted in project delay costs of $96,000 per month, while the largest project resulted in project delay costs of $447,000.

While the methodology is simple, there is no rule of thumb because project delay costs depend on several variables, primarily location, traffic, construction costs, and travel speeds.

The methodology also includes a monthly local economic impact component, which for the three examples ranged from $10,000 per month to $78,000 per month.

The appendices to this report contain data, terminology, and methodologies developed in this research:

- Appendix A—List of Acronyms.
- Appendix B—Description of Calculations Used in Estimating Project Delay Costs.
- Appendix C—General Information Regarding Delays.
- Appendix D—Additional Examples of Project Delay.
- Appendix E—Typical Causes of Delay.
- Appendix F—Delayed Projects Studied.

Appendix D illustrates case examples of projects or circumstances that either have a largely undefined impact or are too complex for this straightforward methodology to assess the delay impacts.

APPENDIX A—LIST OF ACRONYMS

AGUA	Aquifer Gardens for Urban Areas
CAMPO	Capital Area Metropolitan Planning Organization
CE	Categorical Exclusion
DCIS	Design Construction Information System
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
FY	Fiscal Year
HCI	Highway Cost Index
MPO	Metropolitan Planning Organization
NEPA	National Environmental Policy Act
PS&E	Plan, Specification, and Estimation
RMA	Regional Mobility Authority
ROD	Record of Decision
ROW	Right of Way
TTI	Texas Transportation Institute
TURF	Texans United for Reform and Freedom
TxDOT	Texas Department of Transportation

APPENDIX B—DESCRIPTION OF CALCULATIONS USED IN ESTIMATING PROJECT DELAY COSTS

Variables

The output of the model provides both direct and indirect cost estimates. Direct cost estimates include wasted time and fuel for both personal and commercial travel. Indirect cost includes the economic impact of project delay. The spreadsheet-based model uses 17 variables divided into three categories to calculate direct and indirect costs associated with project delay. Those variables include the following.

Calculations Tab

- **Project Cost**—in millions of dollars. This is the contracted amount.
- **Average Annual Daily Traffic before the Improvement**—determined for the segment that most closely represents the roadway segment under construction.
- **Average Annual Daily Traffic after the Improvement**—determined for the segment that most closely represents the roadway segment under construction.
- **Percent of Trucks before Improvement**—determined for the segment that most closely represents the roadway segment under construction.
- **Percent of Trucks after Improvement**—determined for the segment that most closely represents the roadway segment under construction.
- **Persons per Vehicle**—a default value of 1.25 persons per personal vehicle.
- **Average Speed before Improvement**—determined for the segment that most closely represents the roadway segment under construction.
- **Average Speed after Improvement**—determined for the segment that most closely represents the roadway segment under construction.
- **Length of Segment in Miles**—determined from the construction contact.
- **Personal Value of Time**—determined by using the value of personal time used in the most recent *Urban Mobility Report* published by TTI.
- **Commercial Value of Time**—determined by using the value of personal time used in the most recent *Urban Mobility Report published* by TTI.
- **Return on Investment**—the default is 8 percent annually, based on a Federal Highway Administration report by Nadiri and Mamuneas.[3]
- **Percent of Increase in Highway Cost Index**—determined by using the Highway Cost Index published monthly by TxDOT.
- **Total Months of Delay**—determined using the dataset of highway construction projects furnished for this study by TxDOT.

Fuel Tab

- **Fuel Price**—the current fuel price.

Economic Impact Tab

- **Multiplier**—an estimate of the general multiplier for economic activity based on the state's economic profile.
- **Percent Profit**—the average profit margin across all business based on the state's economic profile.

Calculations

The following general steps are used in calculating an estimate of the cost of project delay:

1. Convert daily traffic into monthly traffic volume.
2. Calculate the travel time for the segment under construction for both before the improvement was started and after it was completed.
3. Calculate the total hours of travel over the segment for both before the improvement was started and after it was completed.
4. Calculate the total personal hours of travel using the number of personal vehicles traveling the segment multiplied by average occupancy. Calculations are performed for both before and after the improvement.
5. Calculate the total vehicle hours of travel for commercial vehicles. Calculations are performed for both before and after the improvement.
6. Calculate the net hours of delay by subtracting the "before" and "after" delay for both personal and commercial travel.
7. Multiply the excess hours of delay for personal and commercial travel by the respective value of time to obtain the delay cost associated with the construction delay.
8. Determine the net cost of fuel for commercial vehicles using a fuel/speed curve developed for use in TTI's *Urban Mobility Report,* comparing the amount of fuel consumed at the "before" speed versus the "after" speed, and using the respective volumes for the two periods.
9. Multiply the difference in fuel consumption at the "before" speed and the "after" speed by the prevailing retail fuel price to obtain the fuel cost for personal and commercial travel associated with the construction delay.
10. Calculate the economic impact by multiplying the capital investment by the rate of return (assumed to be 8 percent per annum) plus the annual return multiplied by the assumed rate returned to profit.
11. Calculate the cost of construction inflation by taking the difference between the contract amount at the date the project begins minus the discounted value of the contract at the date the project was originally scheduled to begin. Use the HCI to calculate the discount rate.

APPENDIX C—GENERAL INFORMATION REGARDING DELAYS

This appendix contains a general explanation of three typical areas in which projects can be delayed: regulatory delays, environmental review delays, and legal actions. Because of the statutory nature of these processes, TxDOT must follow defined procedures throughout each area until the final resolution.

Regulatory Delays

The National Environmental Policy Act (NEPA) requires federal agencies to outline the environmental impact their proposed actions will have and to assess the impacts of alternative actions.[4] TxDOT projects funded in any part by federal monies are required to gain environmental approval through the NEPA regulatory process defined by three levels of analysis as shown in Table C-1.

Table C-1. NEPA Levels of Analysis.

NEPA Level	Description
Categorical Exclusion (CE)	This status is given to those projects that do not significantly impact the environment.
Environmental Assessment (EA)	An EA must be conducted when the environmental significance is unknown. The results of an EA can lead to one of the following: • Finding of No Significant Impact (FONSI). • Environmental Impact Statement.
Environmental Impact Statement (EIS)	An EIS is a more in-depth report that must include consideration of alternatives and public involvement. The EIS consists of four steps: 1. Notice of Intent (NOI). 2. Draft EIS (DEIS). 3. Final EIS (FEIS). 4. Record of Decision (ROD).

If a final EIS is not submitted within three years from the date of the draft EIS, or there have been no major steps to advance the action three years after a final EIS (e.g., authority to begin final design or to acquire right of way), a written evaluation should be prepared to determine if a supplemental EIS is warranted.[5] A supplemental EIS is necessary if considerable changes have been made to the project, or there is significant new information available. A supplemental EIS is developed like any other EIS, excluding the need for scoping. Furthermore, once a project

[4] U.S. Environmental Protection Agency. Environmental Impact Statement Process. http://www.epa.gov/compliance/nepa/eisdata.html.

[5] CFR Title 23, §771.129. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title23/23cfr771_main_02.tpl.

has received an ROD, FONSI, or CE, a verification that the designation remains in place should be made prior to any major approvals or grants.[5]

Environmental Review Delays

Projects that do not necessarily fall under NEPA regulations may still have environmental impacts that must be addressed. The safety of roadway users and the cost of avoiding environmental impacts are factors that must be weighed against environmental and aesthetic interests. A concerned citizen or environmental group may delay the project by requesting changes that mitigate the harm or by bringing suit in a state court (as opposed to a NEPA suit in federal court).

Legal Actions

When a lawsuit is filed in reference to a proposed or active project, the party bringing suit may seek an injunction to bring current work to a halt regardless of the stage of progress. If the court grants the injunction, the project will be suspended in its entirety or in part until a court can hear arguments from both sides and rule on the matter. If the injunction is denied, the opposing party can still file suit with the hope of either receiving a favorable ruling before damage has been done or TxDOT addressing the problem to avoid the additional cost and delay.

APPENDIX D—ADDITIONAL EXAMPLES OF PROJECT DELAY

TTI selected three additional projects as examples to illustrate the different causes of delay, costs associated with the delay, and potential complexity in estimating delay costs from one project to another. The following projects were selected:

- US 281 (Bexar County) in the San Antonio District (major highway expansion delayed several years).
- SH 45 Southeast (Travis County) in the Austin District (new connector highway delayed several years).
- SH 16 (Bandera County) in the San Antonio District (safety improvements delayed several months).

Each case study examines the type of delay incurred, a timeline of actions taken, and the ultimate result of the delay, as of 2009. Researchers did not select projects because they represent the *typical* delayed project or signify *usual* resolutions to overcome delays. Rather, researchers chose these projects because they illustrate the magnitude and complexity of actions taken to resolve the issues that cause project delay. Project delays examined in these cases fit into one or more of the following categories: regulatory, environmental, and/or legal. Appendix C contains a general description of the processes associated with each category and how they can cause project delays.

US 281—San Antonio

The US 281 project is an example of an initially straightforward project that became very complex because of multiple and fractured delays. TxDOT employed a variety of improvements to reduce the impacts of the various delays.

The segment of US 281 in San Antonio studied stretches north from Bitters Road (south of Loop 1604) to Borgfeld Road (Figure D-1).[6] Major intersections included in this improvement are Loop 1604, Sonterra Boulevard, Encino Rio Road, Evans Road, Stone Oak Parkway, and Marshall Road.

[6] Map source: Alamo Regional Mobility Authority, http://www.alamorma.org/index.cfm/projects/us-281-eis/.

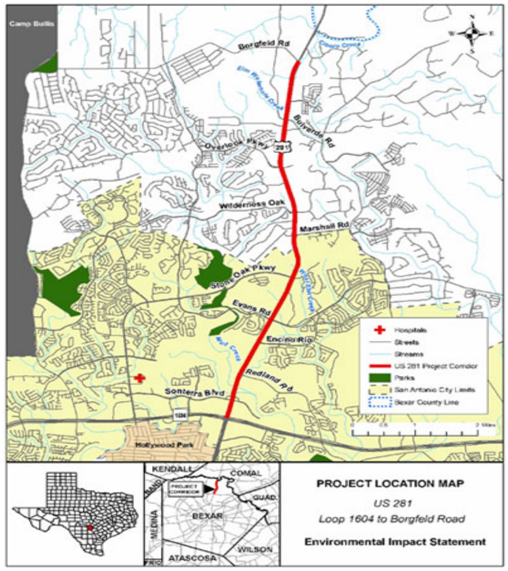

Figure D-1. Map of US 281 Expansion Project.

While the project involved multiple legal battles, this study focuses primarily on delays caused by the environmental regulatory process. Lawsuits filed by citizens' groups required the environmental studies to be repeated and, at times, restarted the regulatory process required to gain environmental clearance.

Because of the delays, several short-term fixes have been proposed as separate projects requiring no environmental analysis to help alleviate the congestion. Improvements to the US 281/Loop 1604 interchange were eventually developed as one of these separate projects, independent of the sizeable US 281 North expansion project.

Timeline

Original Environmental Assessment

In 1984, the US 281 North expansion from Bitters Road to Evans Road was given environmental clearance after an EA was conducted.

In the early 1990s, a segment of this project was constructed from Bitters Road to Sonterra Boulevard.

In 2000, the environmental clearance for construction from Sonterra Boulevard to Evans Road was reevaluated because more than 15 years had passed since the first EA was conducted.

In 2001, development from Loop 1604 to Evans Road was approved by the MPO. The MPO dedicated about half of the estimated needed funds ($42 million) in its 2002–2004 Transportation Improvement Program.

In 2003 and 2004, the US 281 North project was studied to determine whether tolling new lanes would be a practical funding solution, and the following year the MPO voted to construct the new lanes as privately funded toll facilities.

In 2005, TxDOT received unsolicited bids for a privatized toll project. That same year environmental clearance was granted for the segment stretching from Evans Road to Borgfeld Road.

2005: First Lawsuit

Construction of an $80 million expansion segment from Loop 1604 to Marshall Road was halted at the end of 2005 when local environmental groups—Aquifer Guardians for Urban Areas (AGUA) and Texans Uniting for Reform and Freedom (TURF)—sought a court order enjoining the continuation of construction. The Federal Highway Administration (FHWA) withdrew environmental approval because of the lawsuit, and a new EA commenced.

2007: Second Environmental Assessment[7]

In 2007, TxDOT completed a two-year, $2 million EA that combined all projects on US 281 from Loop 1604 to Borgfeld Road. As a result, FHWA published a FONSI that ended the construction moratorium. That same year, Texas passed legislation that changed the way privatized transportation tolling operated, and the Alamo Regional Mobility Authority (RMA) took control of the US 281 project.

2008: Second Lawsuit

In 2008, AGUA and TURF once again brought suit to question the environmental clearances that were currently in place. During the suit, TxDOT requested a 60-day stay to review the records. During this period of review, TxDOT found irregularities in the procurement of scientific services, leading FHWA to retract the previously issued environmental clearance. Any future expansion projects in the US 281 corridor would be required to prepare a more complex EIS. Three weeks after the FHWA pronouncement, the Alamo RMA began pursuing an EIS that they estimated would take three to five years to complete. Consequently, the district judge administratively closed the second lawsuit.

2009: Categorical Exclusions

With the US 281 North expansion projects on hold awaiting a new EIS, the Alamo RMA continued to search for new ways to relieve congestion and improve safety within the limits of the law. In March 2009, the Texas Transportation Commission approved $80 million in federal stimulus funding to aid a separately proposed $130 million improvement project at the US 281/Loop 1604 interchange. The project would include construction of four direct connectors from Loop 1604 to US 281. The Alamo RMA conducted new biological surveys of the area and held two public hearings. In February 2010, FHWA and the U.S. Fish and Wildlife Service approved a CE by granting the interchange project environmental clearance. A portion of the federal stimulus funds must be spent by 2015.

In the fall of 2009, another project to transform a segment of US 281 into a “Super Street” received environmental clearance through a CE. This conversion will aid in congestion relief without the addition of new lanes until the EIS is completed.

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[7] Alamo RMA. Alamo RMA Responds to Latest Lawsuit Filed by TURF, February 26, 2008. Memorandum, FY 06 Lettings, Dianna F. Noble, P.E., January 3, 2007.

2010: Third Lawsuit

In August 2010, AGUA filed suit claiming that the US 281/Loop 1604 interchange project violates the Endangered Species Act and endangers the Edwards Aquifer. In December, AGUA filed an injunction to stop the impending construction for the duration of the suit.

Current Status

A district judge issued an advisory in February 2011 stating that he would rule on the injunction to halt the interchange project within six months. On March 2, 2011, construction began on the US 281/Loop 1604 interchange and will continue while awaiting the court's ruling. Furthermore, the EIS for the US 281 North expansion project is underway, and final approval is estimated for 2013. Figure 7 displays the project timeline, when the original delay began, and when the short-term projects were implemented to help reduce congestion. In addition to the project timeline, Figure D-2 also shows the length of delay the agency and the public encountered because of the project.

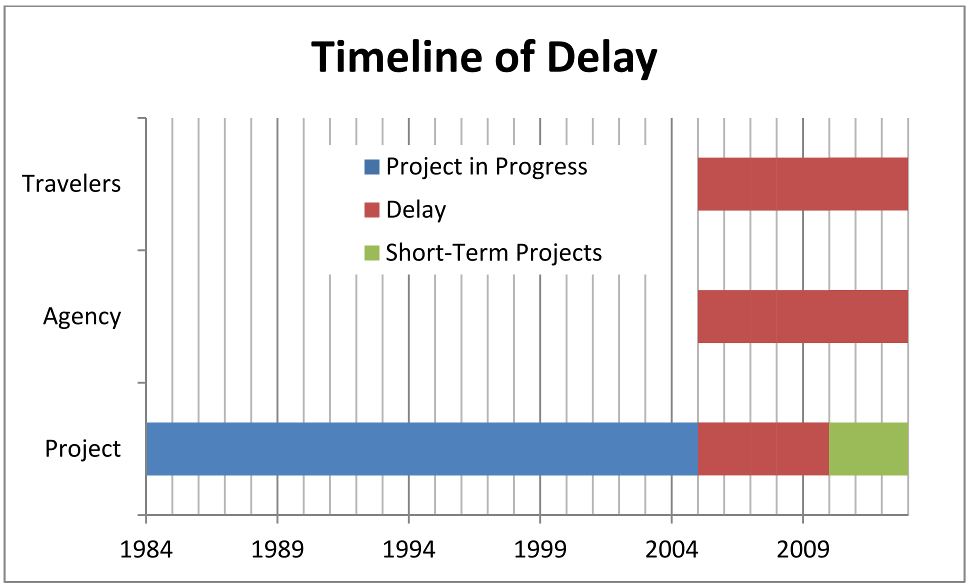

Figure D-2. Historical Timeline of US 281 North Expansion Project Delay.

Costs

US 281 North Expansion Project

Before the first lawsuit in 2005, the low bid to construct the expansion was $83,653,101. The cost to terminate the project that same year was $7 million excluding litigation expenses. Today, the low bid for the same scope of work is estimated to be $2.5 million more than the 2005 bid.

US 281/Loop 1604 Interchange Project

The Loop 1604 interchange project was a short-term project created to help relieve congestion while the US 281 North expansion project was put on hold. The interchange, which is not a tolled project, was partially funded with federal stimulus dollars. The Alamo RMA stated that if the injunction is granted, the delay could cost them up to $30,000 a day.[8]

In addition to the $9.5 million costs specifically mentioned above, additional personal, business, and economic costs are also associated with the project delay.

SH 45 Southeast—Austin

The SH 45 Southeast project is an example of a project on a new alignment, which is generally not suitable for a simplified analysis. This project connects two major highways in a growing network. In the absence of "before" conditions for comparison, a delay impact analysis on a project of this type would require the use of the local travel demand model maintained by the MPO to identify the number of prospective users.

The segment of SH 45 in Austin studied is a 7.4-mile stretch running east/west between IH 35 at FM 1327 and the junction of SH 130 and US 183 (Figure D-3).[9] Major intersections along the four-lane tolled highway include IH 35, North Turnersville Road, FM 1625, and SH 130/US 183. The roadway was proposed as an alternate route for through traffic that would aid in relieving congestion on other major routes (such as IH 35 through downtown Austin). This project encountered delays involving a lawsuit based upon the NEPA's EIS requirements.

[8] Vianna Davilla, quoting RMA Director of Community Development Leroy Alloway. "Interchange Work Starts in Face of Controversy." *San Antonio Express-News*, March 3, 2011.

[9] Map source: TxDOT, http://www.texastollways.com/austintollroads/english/map.htm.

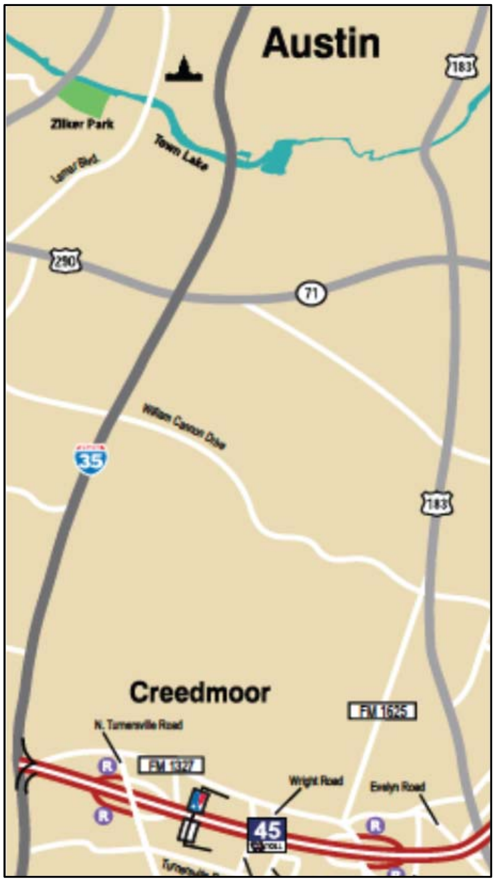

Figure D-3. Map of SH 45 Southeast Project.

Timeline

Original Schedule

In 2003, the DEIS required by NEPA was completed, and a public hearing was held that summer. That fall, the FEIS was submitted, and FHWA granted the project environmental clearance in 2004. That same year, TxDOT awarded a contract to design and build the highway in the following two years to Zachry Construction Company.

2004: Lawsuit

In 2004, local environmental groups Save Our Springs Alliance and Save Barton Creek Association brought suit in federal district court to stop the project. Together the membership of these two groups totals approximately 4,500 people. They claimed the EIS failed to consider an adequate range of alternate routes and did not fully examine the impacts (direct, indirect, secondary, and cumulative). They argued that to completely assess the secondary and cumulative impacts of the southeast project, the future southwest project would need to be analyzed in conjunction. The future southwest segment (segment 3) would cross the Edwards Aquifer recharge zone. The suit and project were put on hold so a new environmental study of the southeast segment could be performed.

2007: Project Restarted

The new environmental study was completed two years later, reaching the same conclusions as the previous analysis. FHWA approved the new study in the summer of 2006, and the federal court dismissed the case. In April 2007, a new contract was awarded to Balfour Beatty Infrastructure, Inc., and T.J. Lambrecht Construction, Inc., and construction began the following July. SH 45 Southeast opened in June 2009. Figure D-4 illustrates the project timeline including when the delay began and when the project restarted. Also shown is the length of delay encountered by the agency and the public because of the lawsuit.

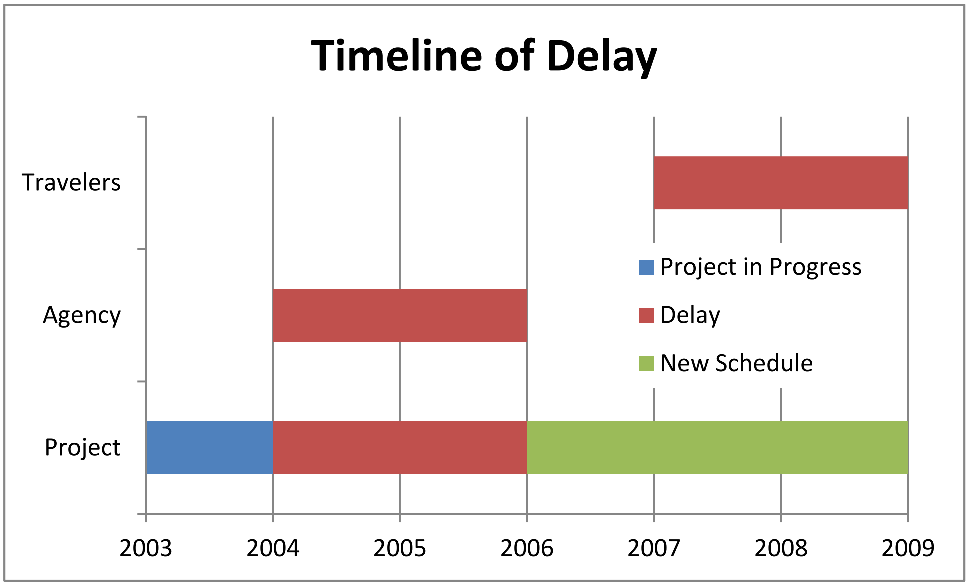

Figure D-4. Historical Timeline of SH 45 Southeast Project Delay.

Costs

The project was originally estimated at $154.3 million as part of a $2.2 billion toll road package approved by the Capital Area Metropolitan Planning Organization (CAMPO). The estimate included $137.4 million for construction costs. TxDOT paid $1.6 million to terminate the project in 2004. The ensuing environmental analysis cost an additional $300,000. During the two years the environmental analysis was being conducted, the cost to acquire right of way rose roughly $5.2 million. Since the project was originally awarded as a design/build project as opposed to design/bid/build, the engineering plans remained incomplete. This meant that an additional $950,000 had to be spent to finalize the engineering plans.[10] The new low bid for the construction portion of the project was $139.7 million—$2.3 million more than the original estimate.

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[10] Texas Department of Transportation. Draft Testimony, "Accelerating the Project Delivery Process: Eliminating Bureaucratic Red Tape and Making Every Dollar Count." House Transportation and Infrastructure Committee Subcommittee on Highways and Transit, February 15, 2011.

Additionally, a project under construction on SH 130 was impacted by the SH 45 Southeast delay, and expenses to settle the matter with the developer cost TxDOT approximately $15.5 million.

In total, the costs associated with project delay on this project exceed an estimated $22.6 million plus an uncalculated amount of commercial and personal delay and economic costs.

SH 16—Bandera

This SH 16 road safety improvement project runs 8 miles from Winans Crossing toward Medina in Bandera County (Figure D-5).[11] The rural state highway originally consisted of two 10-foot-wide lanes with no shoulders. The improvements would widen the existing lanes to 12 feet and add 5-foot shoulders to each side. The current TxDOT standards call for 7 feet of clear zone. The clear zone provides a safe area for drivers to stop or recover their vehicle after veering off the travel lane and is measured from the edge of the travel lane.[12] This project was challenged with a state lawsuit concerning the removal of five mature pecan and black walnut trees located at the intersection of SH 16 and Kyle Ranch Road. These trees, estimated to be 180 to 310 years old, sit directly adjacent to the original road and were scheduled for removal to facilitate the widening of the road.

Timeline[13]

2005: Rural Transportation Meeting

In late 2005, a rural transportation meeting was held to present local projects to the community. TxDOT had performed an environmental study that identified these trees on state property. The original proposal called for removal of five trees, with TxDOT planting 10 new trees in the surrounding grove on state land.

[11] Copyright 2010 Navteq; copyright 2010 Microsoft.

[12] TxDOT Glossary. http://onlinemanuals.txdot.gov/txdotmanuals/glo/c.htm.

[13] Texas Department of Transportation v. Kyle, No. 04-06-00762-CV, May 9, 2007.

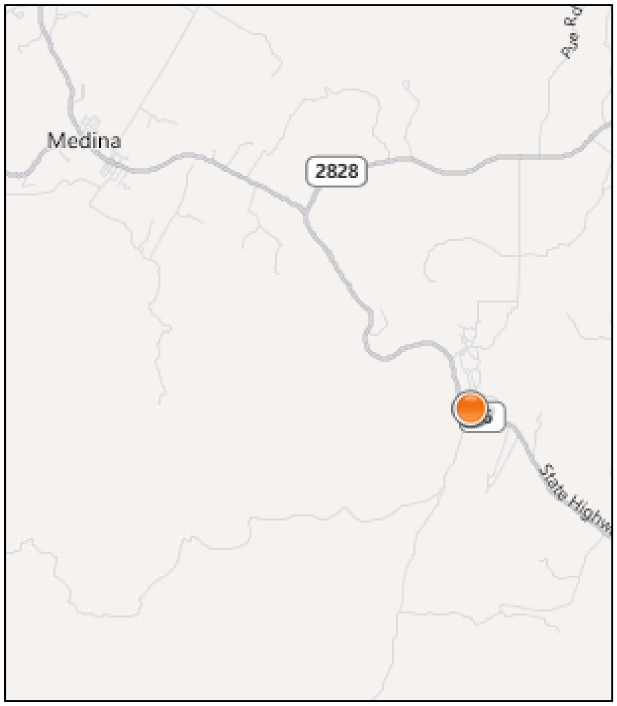

Figure D-5. Map of SH 16 Project.

2006: Lawsuit

In February, TxDOT's Environmental Affairs Division classified the project as a CE needing no further environmental study.

In May, local landowners whose property is adjacent to the intersection met with TxDOT to voice their concerns. TxDOT amended the plans to include a guard rail that would run between the road and the trees, thus reducing the number of trees to be removed to two.

On June 1, the landowners filed suit in state court seeking to stop TxDOT from removing any of the trees and classifying the project as a CE. A temporary restraining order was granted, and a hearing was held on June 26.

On June 26, at the hearing's conclusion, the judge requested the parties agree on a temporary injunction. TxDOT immediately requested the case be removed to federal court. The state court denied TxDOT's request and granted the temporary injunction, stopping TxDOT from removing any tree within one-half mile of the intersection in question.

On October 31, the federal court also denied TxDOT's request for removal to federal court, stating that TxDOT is not a federal agency and was not subject to federal rules. The project's funds did not include federal monies that would require NEPA approval.

On November 1, the temporary injunction was renewed. Construction was completed for the remainder of the project with the exception of the contested intersection.

2007: State Appeal

In early 2007, TxDOT filed an appeal stating that the state trial court was not the correct court to decide the matter. TxDOT argued that it has sovereign immunity. However, sovereign immunity does not exist if the state is depriving the other party of a vested property right. The court agreed with TxDOT that the landowners do not have a vested interest because the trees are located on state land. The Fourth Court of Appeals of Texas reversed the decision of the trial court and removed the injunction, thus allowing TxDOT to proceed. On August 1, 2007, the two trees in question were removed. Figure D-6 illustrates the project timeline showing when the delay began and when the project was allowed to resume in the contested area. Additionally, Figure D-6 shows the length of delay the agency and the public encountered.

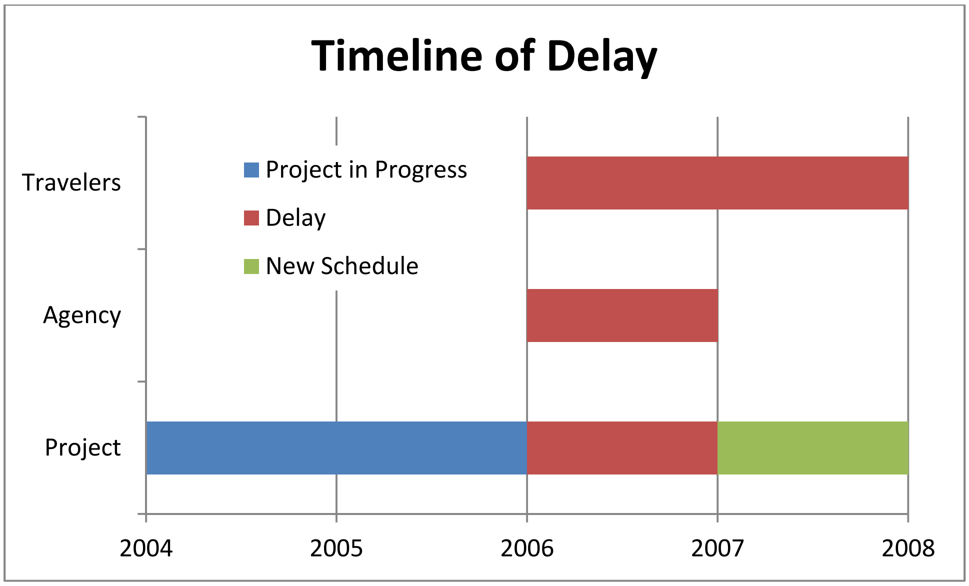

Figure D-6. Historical Timeline of SH 16 Project Delay.

Costs

The project was originally estimated at $5.4 million, funded from the sale of $600 million in bonds in 2004 for safety projects across the state.[14] There was also additional cost to TxDOT that could not be explicitly identified by this research project. In addition to those unidentified costs, the public was denied the additional safety benefits provided by wider lanes and paved shoulders while awaiting the court's ruling.

[14] Jessica Hawley. "Trees Cause Debate in Root of Community." *The Bandera Bulletin*, May 9, 2006.

APPENDIX E—TYPICAL CAUSES OF DELAY

During each stage of a project, numerous events can cause project delays. Table E-1 summarizes the typical causes of delay for a roadway construction project during the four major phases of a project. While the nature of delays can vary among the four stages of a project (planning, development, contracting, and construction), the results are quite similar: impacts on travelers and businesses.

First, with respect to delays during the planning/scoping phase, while the number of potential reasons for delay is relatively small, the length of delay associated with these reasons can be significant. This is particularly the case if the project becomes the subject of litigation.

Although delays during the project development phase can have numerous causes, they are typically invisible to the public unless they have been told a project would start construction by a certain time (e.g., summer 2012). If the construction has not started as anticipated, local stakeholders, citizens, and local media may want to know the causes of the delay. One exception to the concept that delays during development are invisible to the public is when litigation occurs. Such litigation mostly occurs during a statutory review process (e.g., environmental clearance or U.S. Corps of Engineers clearance) or during right-of-way acquisition.

Delay during the contracting phase is typically minimal, with a project only being delayed one or two months from the original letting date due to last-minute procedural missteps and/or project management inefficiencies.

The public generally understands that once a project begins construction, there will be a period of inconvenience while the project is underway. As TxDOT and local media announce the anticipated duration of construction, the public takes a grin-and-bear-it attitude, looking forward to the completion of the project. Delays during construction, however, are the most visible and draw substantial attention.

Table E-1. Typical Causes of Project Delay.[15]

Planning/Scoping

• Project priority changes in relationship to other projects
• Federal/state legislation
• Interagency coordination
• Project management issues:
  o Poor project definition
  o Lack of documentation of assumptions
  o Missed milestones
• Funding
• Litigation

Development

• Project management issues:
  o Poor project definition
  o Lack of documentation of assumptions
  o Missed milestones
• Railroad permits not obtained as anticipated
• Acquisition of necessary right of way (ROW) not completed as anticipated
• Utility accommodation agreements not completed as anticipated
• Mandatory review processes (e.g., environmental and fish and wildlife) not completed as anticipated
• U.S. Corps of Engineers permits not obtained as anticipated
• Local funding agreements not executed as anticipated
• Delay in plan, specification, and estimation (PS&E) preparation (either in-house or by consultant)
• Litigation

Contracting
• Unanticipated letting events (e.g., bids greatly exceeding engineer's estimate) • Delayed assembly of PS&E/letting package • Projects pulled from letting schedule • Bid protests • Litigation

[15] The information contained it Table E-1 is a compilation of data from multiple sources:

- Meeting with TxDOT, Associated General Contractors of Texas, and Highway Contractors in Austin, Texas, June 8, 2011.
- R.D. Ellis and H.R. Thomas. "The Root Causes of Delays in Highway Construction." Transportation Research Board 82nd Annual Meeting, Washington, D.C., January 2003.
- J. Ahn and R.E. Minchin, Jr. "Identifying Causes for Delay in Highway Construction Projects." Transportation Research Board 87th Annual Meeting, Washington, D.C., January 2007.

Table E-1. Typical Causes of Project Delay (Continued).

Construction (after Contract Award)

• Additional work desired by TxDOT
• Additional work desired by another party
• Contractor delays
• Project management issues:
  o Lack of communications, collaboration, and cooperation
  o Lack of approval authority
  o Coordination with stakeholders (local governments and other agencies)
• Utility conflicts/untimely utility accommodations
• Unacquired ROW
• Railroad conflicts (scheduling of work and project prioritization)
• Permitting issues/approvals
• Unforeseen project site conditions:
  o Differing subsurface conditions
  o Archeological impacts
  o Endangered species impacts
  o Environmental impacts
• Design errors/omissions
• Unfavorable weather
• Insufficient work effort:
  o Skilled workforce shortages
  o Equipment shortages
  o Material shortages/price increases
• Events (e.g., holidays, special events, and local events)
• Changes solely for public convenience
• Act of God
• Litigation

Figure E-1 shows the percentage of total days of construction delay by cause of delay. This information was gathered from data collected by TxDOT's Construction Division. In FY 2009, 26.1 percent of the total days of delay is attributable to additional work desired by TxDOT. The second biggest percentage of total days of delay is attributable to contractor delay. In total, these two categories of delay accounted for almost half of all days of delay.

With respect to the additional work desired by TxDOT, in most cases, the delay is more specifically associated with having the opportunity to address a known issue (e.g., other repairs and expanding the limits) while a contractor is on site and a contracting mechanism is in place. Contractor delays are most often associated with weather and waiting for resolutions regarding utility relocation, ROW acquisition, and other agreements/clearances (e.g., U.S. Corps of Engineers, potential wildlife area impacts, and unknown/potential archeological sites).

Figure E-2 shows the same dataset distributed simply by the number of projects affected by delay without respect to the number of days involved. For example, of the approximately 870 projects closed in FY 2009, 223 had at least one day of delay associated with additional work desired by TxDOT.

Of course, projects that experience delay may have delay caused by more than one factor. Figure E-3 shows the distribution of delay by cause. For example, if a project suffered a delay because of a design error by the consulting engineering firm and then later experienced a delay due to weather, both reasons for delay are shown in this graph. As a result, the total frequency of delay across all causes will sum to greater than 100 percent.

Finally, while project delay almost always has cost associated with it, not all project delay is a waste of time and public money. In many instances of project delay initiated by TxDOT, the reason for the delay is to make an improvement in the design or construction of the project that will ultimately deliver better value to the public.

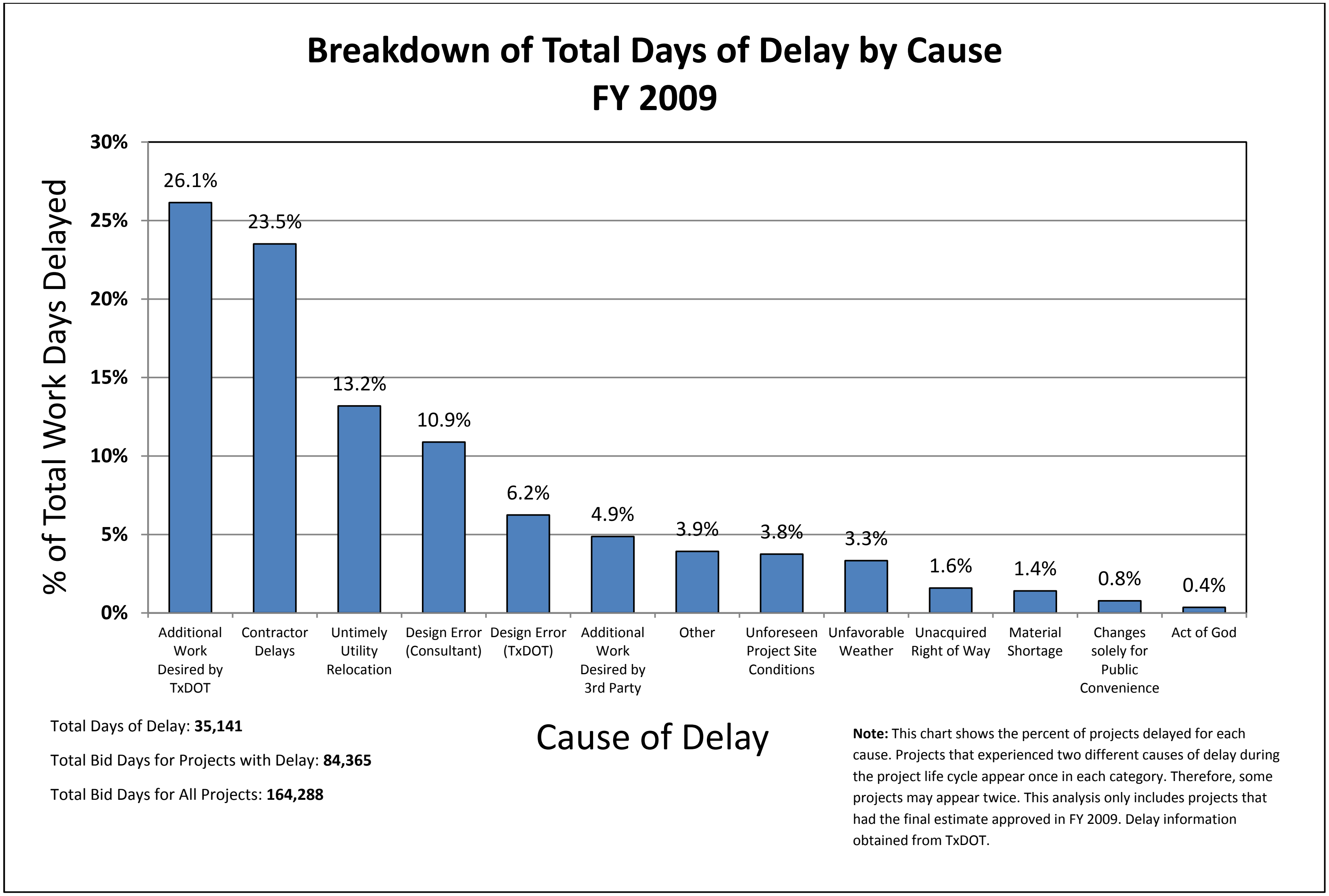

Figure E-1. Breakdown of Total Days of Delay by Cause, FY 2009.

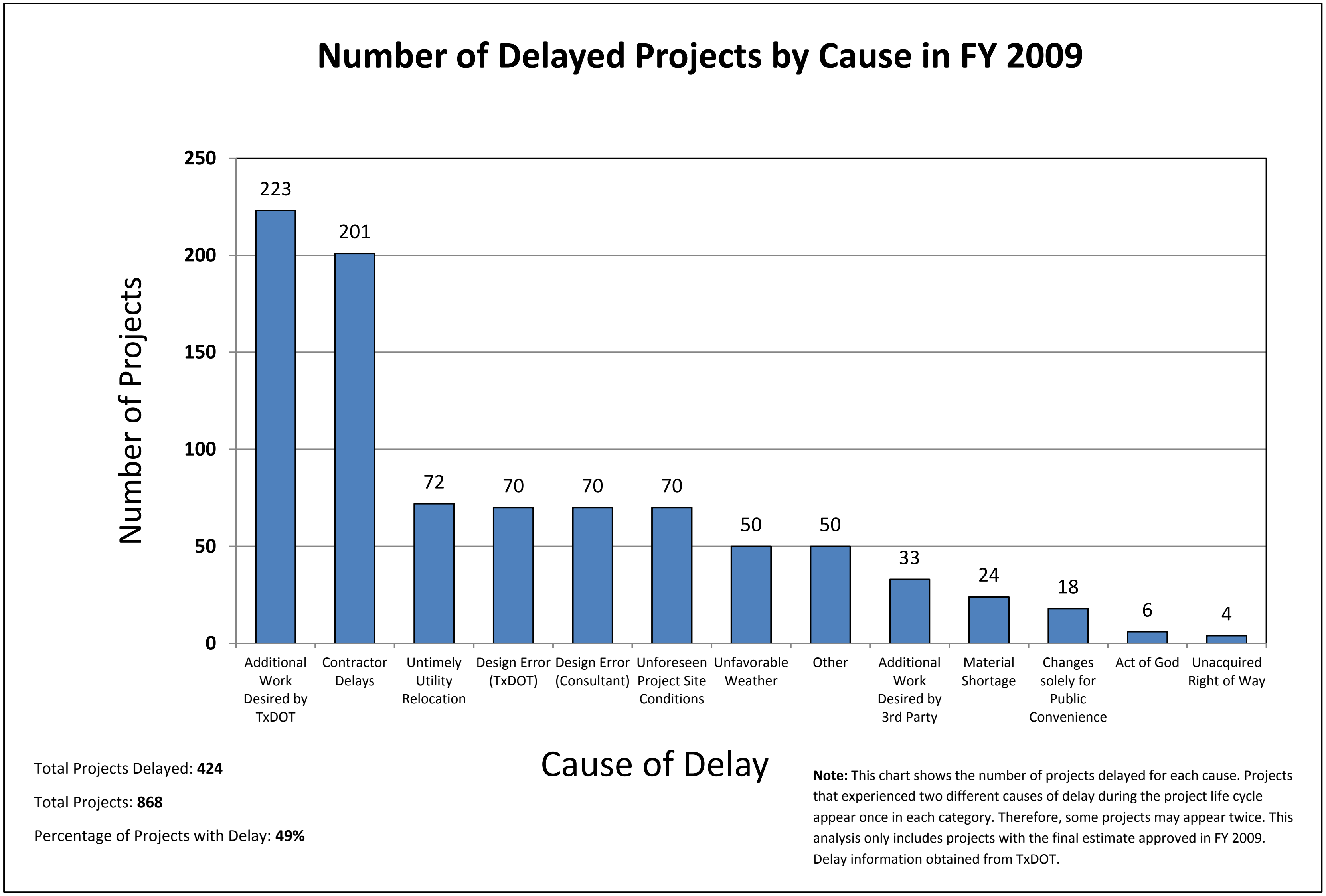

Figure E-2. Number of Delayed Projects by Cause, FY 2009.

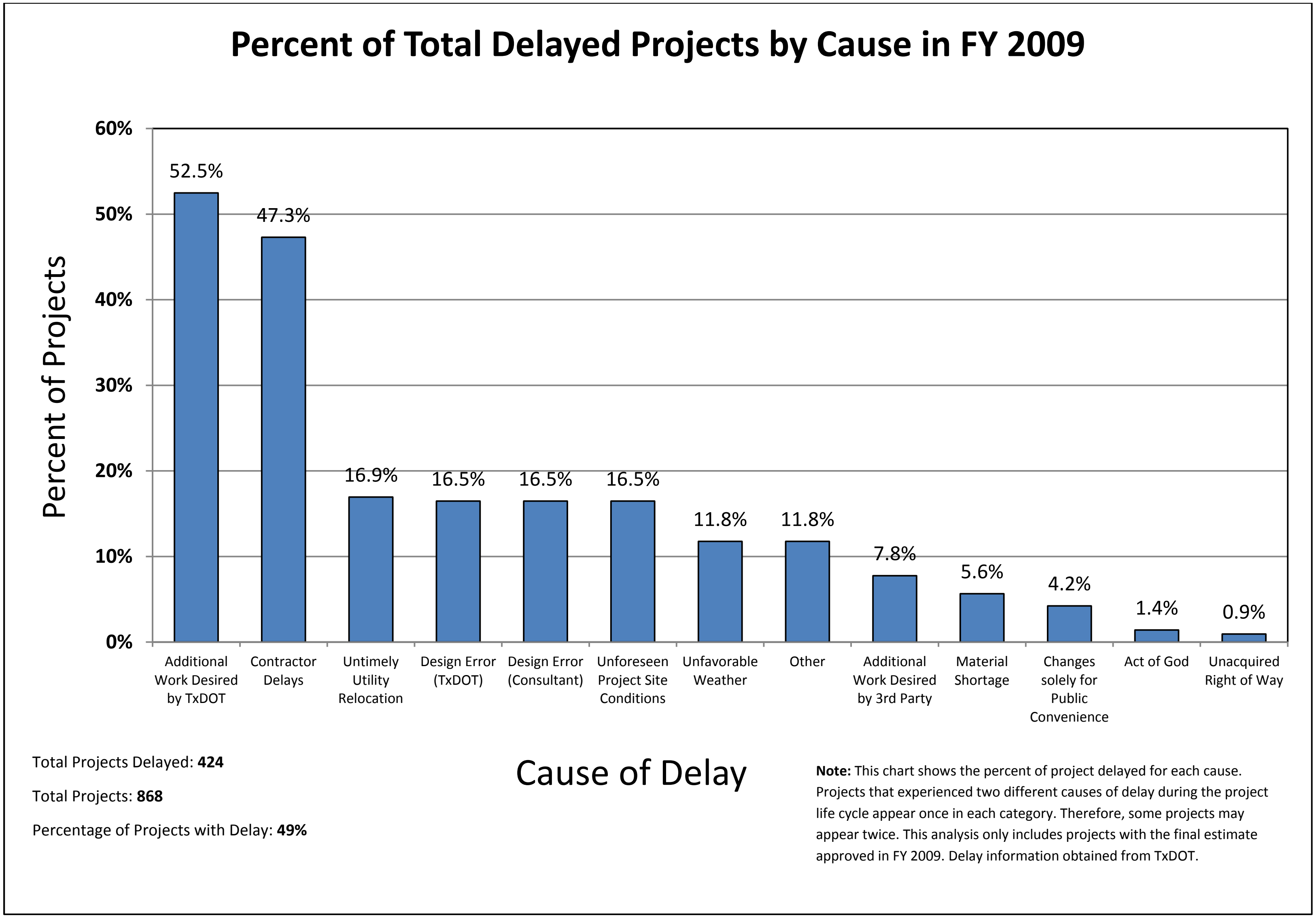

Figure E-3. Percent of Delayed Projects by Cause, FY 2009.

APPENDIX F—DELAYED PROJECTS STUDIED

Project location information, before-and-after average vehicle speed, and other information were required to determine both direct and indirect costs associated with project delay. Therefore, TTI researchers analyzed projects in the Austin, San Antonio, El Paso, Houston, and the Dallas/Fort Worth areas only because the MPOs in these regions provided the minimum data requirements needed for a robust analysis. The list of projects examined is included in Table F-1.

TTI researchers obtained travel demand data provided by large MPOs to calculate speed differentials from improved vehicle movements. Researchers used travel demand data obtained from these projects to develop total cost of delay scenarios for small, medium, and large projects. The specific projects with reported delays used in this analysis were obtained from DCIS, TxDOT's Construction Division, and select TxDOT districts. Note that "TTA" in Table F-1 refers to the Texas Turnpike Authority.

Table F-1. List of 26 Delayed Projects Studied by Total Bid.

Rank	District	CSJ	Highway	Length (Miles)	Project Description	Bid (Total Obligated Amount)	Project Phase When Delay Occurred	Total Days of Delay
1	TTA	3136-01-126	LP 1	1.7	Convert non-freeway to freeway	$107,960,584	Construction	99
2	TTA	0683-06-015	SH 45	1	Convert non-freeway to freeway	$103,017,730	Construction	528
3	TTA	0683-01-069	SH 45	2.5	Widen non-freeway	$101,577,358	Construction	187
4	Dallas	1068-04-083	IH 30	4.7	Widen from six to eight lanes and add interchanges	$96,841,618	Construction	156
5	San Antonio	0072-12-159	IH 10	1.5	Reconstruct IH 10 410 Interchange (crossroads) (Phase 2)	$82,237,875	Construction	332
6	Dallas	0048-08-037	IH 35E	9.8	Upgrade to standards freeway	$62,597,022	Construction	273
7	San Antonio	0072-12-130	IH 10	3.1	Upgrade to standards freeway	$61,990,150	Construction	256
8	Houston	0177-05-057	US 59	2.6	Widen to eight main lanes and two three-lane frontage roads	$49,231,631	Design	
9	Houston	0177-05-057	US 59	2.6	Widen to eight main lanes and two three-lane frontage roads	$49,231,631	Construction	
10	Houston	0027-08-108	US 90A	0.9	Widen to eight-lane divided with improvements at ditch H	$39,243,649	Construction	51
11	Fort Worth	0134-08-030	US 380	10.5	Reconstruct two lanes to four-lane divided rural	$36,540,038	Design	
12	Houston	0027-08-144	US 90A	1.3	Widen to eight-lane divided with diamond interchange at Dulles	$21,881,454	Construction	86
13	Houston	0179-03-024	SH 35	7.7	Widen to four-lane divided rural	$19,702,202	Construction	201
14	Fort Worth	0902-48-708	CS	3.4	Widen from two-lane to four-lane divided urban highway	$19,069,431	Design	
15	Fort Worth	0081-02-045	US 377	2.9	Reconstruct to four-lane divided urban	$12,983,276	Construction	
16	San Antonio	0521-06-124	IH 410	3.7	Rehab existing main lanes and reconstruct shoulders	$12,388,367	Construction	243
17	Houston	0523-10-033	FM 1488	2.7	Widen two lanes to four-lane divided (Pass Through Financing)	$11,463,848	Design	
18	Houston	0179-01-028	SH 35	4	Widen to four-lane divided, widen bridges, and install new bridges	$10,716,917	Design	
19	Houston	0179-01-028	SH 35	4	Widen to four-lane divided, widen bridges, and install new bridges	$10,716,917	Construction	
20	Austin	0114-04-048	US 290	3.8	Widen to four-lane divided rural section	$10,716,016	Construction	162
21	Fort Worth	3125-01-010	FM 3029	1.1	Reconstruct and widen from five to six lanes with raised median	$9,873,767	Construction	
22	Austin	0204-01-049	US 79	1.5	Widen non-freeway	$9,351,883	Construction	384
23	Houston	0027-08-108	US 90A	0.9	Widen to eight-lane divided with improvements at ditch H	$9,238,220	Design	
24	Fort Worth	1068-01-187	IH 30	1.6	Reconstruct to four-lane divided with raised median	$8,559,000	Construction	434
25	Dallas	2374-04-046	IH 20	12.3	Rehab existing freeway	$7,870,576	Construction	69
26	Fort Worth	0718-02-025	FM 156	1	Widen to four lanes with continuous left-turn lane	$7,502,998	Construction	