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16. Abstract
The stimulus package signed by President Obama on March 6, 2009 is known as the American Recovery and Reinvestment Act (ARRA). This act allocated $48.1 billion to transportation of which $27.5 billion was for highway projects. Texas was allotted the second highest distribution of $2.2 billion and by September 1, 2009, 298 projects were authorized and $1.2 billion obligated. The full allocation was taken up by the April 2010 deadline.

State agencies like TxDOT who receive ARRA funds must report, on a monthly basis, various data on each project in the ARRA program including staff numbers, hours worked and payroll. Construction labor, however, is only one part of the full economic impact of highway investment. The direct jobs, such as those reported by the main contractor and the subs, can be smaller than those working in the indirect sector—material suppliers, transportation companies, and so forth. And when those in the direct and indirect sectors are employed, they spend money in a variety of ways to create induced impacts.

This report documents research that explores labor usage on TxDOT ARRA construction projects, including statistical analyses and interviews with contractors and suppliers. It also includes an analysis of the differences observed in labor, material, and equipment costs on ARRA projects compared to 'normal' project costs.

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Employment Impacts of ARRA Funding on TxDOT Projects

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Chapter 1. Introduction

1.1 Background

The stimulus package signed by President Obama on March 6, 2009, is known as the American Recovery and Reinvestment Act (ARRA). The total value of the ARRA program was $787 billion and was comprised of federal tax cuts, the expansion of unemployment benefits (not accepted by Texas), and other social welfare provisions, together with spending on education, health care, energy, and infrastructure. Of the $48.1 billion allocated to transportation, $27.5 billion was for highway projects. Texas was allotted the second highest distribution of $2.2 billion and by September 1, 2009, 298 projects were authorized and $1.2 billion obligated. The full allocation was taken up by the April 2010 deadline.

President Obama promised full accountability and transparency of ARRA funding and a web site (http://www.recovery.gov/) was designed to provide a wide range of material to allow the tracking of expenditures. As part of this, state agencies like TxDOT who receive ARRA funds must report, on a monthly basis, various data on each project in the ARRA program including staff numbers, hours worked and payroll. Construction labor, however, is only one part of the full economic impact of highway investment. The direct jobs, such as those reported by the main contractor and the subs, can be smaller than those working in the indirect sector—material suppliers, transportation companies, and so forth. And when those in the direct and indirect sectors are employed, they spend money in a variety of ways to create induced impacts.

In the summer of 2009, Mr. Rick Collins of TxDOT's Research and Implementation Offcie (RTI) supported an initial review of the ARRA under Project 0-6581 TxDOT Administrative Research. The results of that task were documented in Technical Report 0-6581-1. From September 2000 to May 2010, the same project 0-6581 supported a Policy Research Project (PRP) in the UT LBJ School of Public Affairs led by Dr. Leigh Boske. The results are documented in Technical Report 0-6581-2, and cover an analysis of the supply chains of contractors and likely employment impacts of transportation spending. In this report, the work undertaken by a CTR team to explore labor usage on construction projects is documented, along with an analysis of the differences observed in construction employment during the recent economic recession compared to a 'normal' economy.

1.1.1 Research Approach

The objective of this study was to determine the best way to estimate the indirect and induced effects of the ARRA program in Texas. This was done by surveying other states and selected contractors in the Texas ARRA program. In addition, all ARRA Texas monthly project data was provided to the research team by Ken Barnett, P.E., of TxDOT's Construction Division, who was tasked with preparing and submitting that data to the Federal Highway Administration (FHWA).
Data collected by TxDOT on its ARRA contractors can be regarded as recording the direct impacts of the work. The challenge is to estimate the indirect and induced impacts of the ARRA work. This is important because it is highly likely that such impacts will be substantially higher than direct impacts alone. To accomplish this effort, the research team conducted a number of tasks as described in the next section.

1.2 Research Tasks

Task 1. Review of Economic Impact Models and ARRA State Reporting

The objective of this task was to review how state DOTs are reporting ARRA impacts to the FHWA, and how that compares to TxDOT. The FHWA requirement only covers the direct jobs that traditionally comprise only a portion of the full impacts. The intent was to see if any other state is trying to broaden the impact measurement, identify the method they are using, and collect information on the method so that a decision can be made on the utility of that approach in Texas. Sub-tasks included:

i. Collect literature on Input/Output (I/O) models and various methods for estimating economic impacts.

ii. Survey DOTs using models and contact provider.

iii. Evaluate direct job monthly growth as reported in Texas to FHWA.

Task 2. Maintain TxDOT Reporting ARRA Data Base

The objective of this task was to scope out and develop a prototype database that would present ARRA data in an easily understandable format with graphic capabilities. A relational database was designed during summer 2009 under project 0-6581, and the work in this task was to ensure the data would be compatible with the models and approaches identified in Task 1. Sub-tasks included:

i. Add monthly data reported by TxDOT to FHWA. Analyze the time series data to identify “ramp-up” and “ramp-down” effects.

ii. Adapt database to include data on indirect impacts collected by research team on the ARRA Texas contractors.

Task 3. Survey States for Indirect and Induced Estimates

State DOT web sites were examined and evaluated relative to the ease of access and transparency of their ARRA reporting to the general public. States that appeared to be undertaking additional, more comprehensive analysis of the ARRA economic impacts were contacted for discussions with their planning group. Use of I/O models was of specific interest to the research team and follow-up work was made with staff from those states employing approaches to measure indirect and/or induced impacts. Sub-tasks included:

i. Survey states using their web sites and contacting thereafter if appropriate.

ii. Complex vs. simpler I/O models: Survey DOT use of I/O models and learn more about model structure, data needed, calibration, and effectiveness.

iii. Address the challenge of developing basic indirect impacts for TxDOT projects and the induced impacts thereafter.

Task 4. Analyze Direct Job Estimates in Texas and Scope Indirect Impacts

The objective of this task was to understand labor usage on ARRA projects compared to 'normal' projects. ARRA projects were analyzed by work activity to more accurately capture differences in direct labor impact. This analysis provided insights into indirect impacts in materials and equipment used. Indirect impacts will be further scoped through interviews with contractors, conducted in accordance with Institutional Review Board (IRB) guidelines.

The interviews targeted contractors working on the ARRA program who are furnishing employment and payroll data to TxDOT. The assistance of the Texas AGC was sought, and a draft contractor questionnaire was developed. The objective of the questionnaire was to collect data on labor generated through manufacturing and delivering construction materials and equipment, and ancillary jobs created by these activities as well as the primary construction activities.

Research sub-tasks included:

i. Working with TxDOT, group the ARRA program projects into similar work categories.

ii. Visit AGC Texas office and establish contractors who would assist in the design of a survey instrument.

iii. Decide whether to sample or survey TxDOT ARRA contractors.

iv. Structure contractor questions to generate the input data required for those approaches used to estimate indirect impacts.

v. Develop draft questionnaire.

Task 5. Pilot Test Survey Document

The draft questionnaire developed in the previous task was first tested through a pilot version. Feedback from both contractors and the Texas AGC was used to modify and sharpen the final questionnaire, which was then used on the actual interviews with ARRA contractors. Sub-tasks included:

i. Select a sample of ARRA contractors for the pilot survey.

ii. Meet with Texas AGC and make changes as appropriate.

iii. Conduct full survey of ARRA contractors.

iv. Enter data into the Task 2 data base.

Task 6. Analyze Texas ARRA Indirect Impacts

The objective of this task was estimation of indirect impacts of ARRA funding. It was expected that a number of approaches would be possible, especially those which compare *actual* reported indirect impacts in the Texas ARRA program and the *predicted* impacts from the various models. Sub-tasks included:

i. Select and run economic impact models.

ii. Compare output between proprietary and study approaches to measuring impacts.

iii. Evaluate the performance of the models.

Task 7. Analyze Economic Impact Models for Measuring Induced Impacts

This task focused on the third, and final, group of impacts that comprise the benefits induced from direct and indirect employment. In some sectors—like marine ports, for example—such benefits can be larger than both direct and indirect. It is for this reason that at least an estimate of the induced benefits from the ARRA program be attempted. Sub-tasks comprised:

i. Review different approaches and methods to measure the induced impact of highway construction.

ii. Note metropolitan vs. rural differences.

iii. Recommend approach and/or model both for ARRA and for the larger TxDOT annual program.

Task 8. Develop Recommendations

This task summarized the principal findings of the research and the recommendations both for ARRA reporting and for future TxDOT planning use. Accurate predictions of the direct, indirect, and induced impacts from investment in TxDOT highway programs could play an important role in showing the general public how their tax money is being spent and that beneficiaries extend beyond the users of the system. Sub-tasks included:

i. Offer content to the TxDOT ARRA web site.

ii. Summarize and recommend model(s) for estimating direct, indirect, and induced impacts for TxDOT program.

iii. Test these models on a TxDOT program to illustrate the wide range of benefits that are linked to highway investment.

1.3 Organization of This Report

This chapter presented the background and justification for this research effort, and the research tasks. The remainder of the report is organized as follows. Chapters 2–6 present the results of work undertaken in Tasks 1–8. Conclusions and recommendations are in the final chapter.

Chapter 2. The ARRA and Expected Economic Impacts

2.1 Introduction

In 2008, construction lost 632,000 jobs nationally, of which about 100,000 were in Texas. On February 13, 2009, in response to the deepening economic recession, Congress passed the American Recovery and Reinvestment Act. An immediate goal of ARRA was to retain existing jobs and create new jobs while fostering economic stabilization. This historic act provided $787 billion in total funding; TXDOT received $2.25 billion of the almost $26 billion that was allocated to transportation construction nationwide. To track the on-site or "direct" jobs associated with these construction projects, the ARRA stimulus required unprecedented reporting of data associated with direct employment, including the number of employees working at the job site itself, as well as payroll and hours worked.

The employment impacts of the ARRA funds allotted to TXDOT go well beyond the direct jobs on the site; however, the lack of data and a formal measurement system mirroring that of the direct "on-site" jobs make the task of accounting for these indirect and induced job impacts difficult.

2.2 Economic Impacts of Transportation Investments

Many studies have been done by researchers to assess direct and indirect economic benefits of transportation projects. Glen Weisbrod and Burton Weisbrod[1] in their study have explained the fundamental options and tradeoffs involved in selecting the right kind of techniques for assessing economic impacts and explain how to match appropriate methods to different kinds of applications or situations. According to them, the economic impacts and their mode of measurement are:

- Business output (or sales volume): This includes gross level of business revenue, which pays for costs of materials and costs of labor, as well as generating net business income (profits). Although this could be misleading because distinction between a high value-added activity (generating substantial local profit and income) and a low value-added activity (generating relatively little local profit or income from the same level of sales) is not made.
- Value-added (or gross regional product): This measure essentially reflects the sum of wage income and corporate profits generated in the study area. However, in today's increasingly global economy, value-added can be an over-estimate of the true income impact on a local area. Hence, it can be used as an appropriate measure of impact on overall economic activity in a geographic area, the personal income (wage) is a more conservative measure of benefit to the residents of the area.
- Wealth (including property values): Property values are also a reflection of generated income and wealth. However, it would be double counting to add property value impacts to income or value-added impacts.
- Personal income (including wages): Aggregate personal income rises as economic activity increases. This can be a reasonable measure as long as nearly all of the affected

workers live in the study area. However, it is still an under-estimate of the true economic impact.

- Jobs: Total employment reflects the number of additional jobs due to economic growth. This is a popular measure but has two major limitations: (1) it doesn't reflect the quality of employment opportunities, and (2) it cannot be easily compared to the public costs of attracting those jobs.

Those authors also propose that multipliers can be used to assess indirect and induced business impacts for a program. For most industries, these multipliers are generally around 2.5–3.5 for national impacts, 2.0–2.5 for state impacts, and 1.5–2.0 for local area impacts.

Another paper published by the International Association of Public Transport,[2] "Assessing the Benefits of Public Transport," enumerates the importance of such assessment. The paper goes on to describe the qualitative benefits of understanding the full benefits of public transport. However, the paper does not provide or suggest any quantitative or analytical tools that can enable such assessment.

A paper on "Economic Benefits of Public Investment in Transportation" by Bhatta and Drennan[3] concludes that the real long-term effects and benefits of transportation projects, whether on production costs, productivity, wages, or employment, are likely to be place-specific. Also, government investment in transportation infrastructure definitely results in long-term economic benefits on the production or supply side, such as increased output, increased productivity, reduced costs of production, or increased income. Transportation planners who can show such positive benefits accruing from their preferred projects could trump competing project alternatives. Again, that paper does not provide any analytical methods that can help in such assessments.

2.3 The ARRA—Genesis and Goals

The United States has just gone through the largest economic recession since the Second World War, and although the worst may be over, has not returned to growth. IHS Global Insight had estimated that the world economy would rebound sharply out of negative growth in late 2009 and 2010 as shown in Figure 2.1, but that has not been the case. Economists believed that the most recent recession would be similar to earlier ones in 1993 and 2001, though others took a more cautious view. And while it is true that the world economy is generally moving back into the black, individual nations have struggled and encountered difficulties.

In the U.S., concern over the strength of the financial sector (critical for facilitating global trade) has compounded the difficulty of accurately predicting future economic growth. U.S. Administrations have tried to address and mitigate the magnitude of the economic downturn by enacting three stimulus programs since 2007. The first, introduced in 2007 by President Bush, returned money in the form of "stimulus checks" to a substantial number of tax payers. Evidence collected as part of measuring its effectiveness suggests that much of the money was used to pay down personal debt (on credit cards, for example) rather than stimulate economic activity.

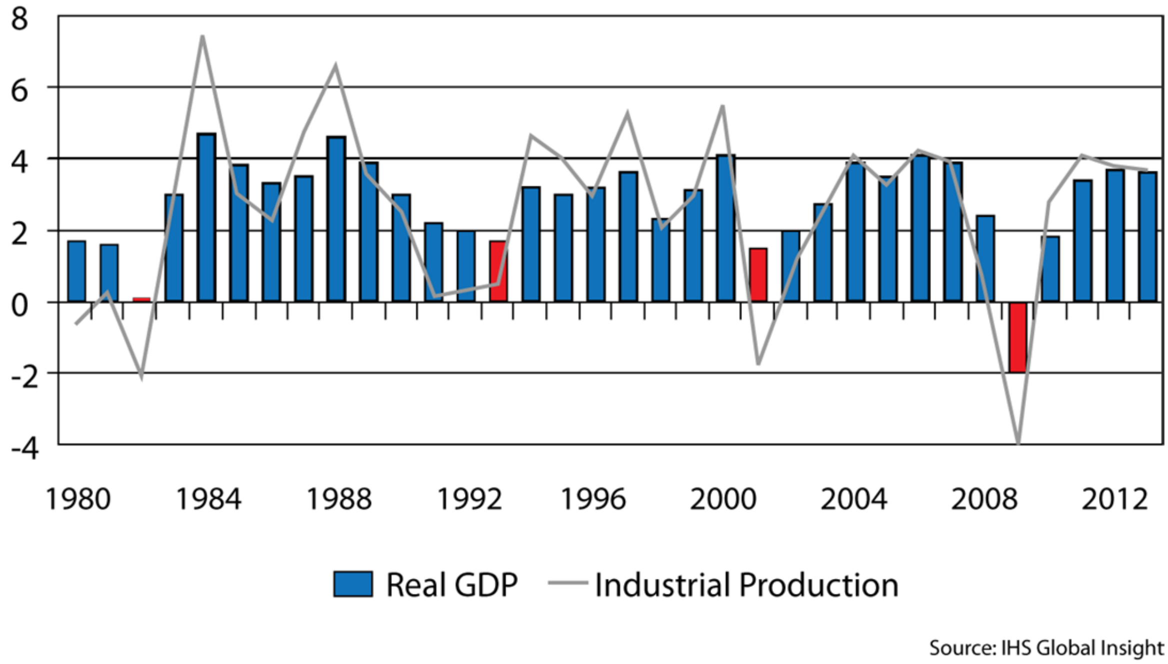


Figure 2.1: World Gross Domestic Product and Industrial Production,1980–2009, Estimated to 2012

The next federal initiative was begun by President Bush in 2008 and carried on by President Obama and addressed the collapse of key financial institutions, in part linked to faulty sub-prime mortgage loans and other risky financial instruments that created instability in financial and credit markets. This program was successful in stabilizing banks (and then auto companies) to the point where the money loaned kept banks within the federal operating guidelines and the money is now being returned to the government. However, the program did little to stimulate economic growth. It might have created the economic stability in financial markets, however, upon which U.S. economic growth can now be built. The development of this program created many philosophical arguments that compounded the shape and content of the alternative forms of potential stimulus programs. These included those arguing that "moral hazard" should prevail and badly run banks and auto companies should face the consequences of their strategies and, if necessary, go the wall.

The third approach, which is the subject of this study, was developed by the White House and Congress with advice from a wide range of groups, including Keynesian approaches containing trillions of dollars aimed at a wide variety of job-creating activities The outcome was one of compromise, containing programs of economic activity of a Keynesian nature (creating or supporting jobs), programs that evaluated new economic activities (like High Speed Rail) and ear-marked programs that covered a wide variety of activities, some of little value to the basic stimulus objectives. The draft stimulus package introduced by President Obama in January 2009 came back for his signature in a changed form as the American Recovery and Reinvestment Act on March 6, 2009. The total value of the ARRA program was $787 billion and comprised federal tax cuts, expansion of unemployment benefits (not accepted by Texas) and other social welfare provisions, together with spending on education, health care, energy, and infrastructure.

In the ARRA, $48.1 billion was obligated for transportation, including:

- $27.5 billion for U.S. highways
- $8.4 billion for transit
- $8.0 billion for high speed rail
- $1.3 billion for Amtrak
- $1.5 billion for National Surface Transportation Discretionary Grants

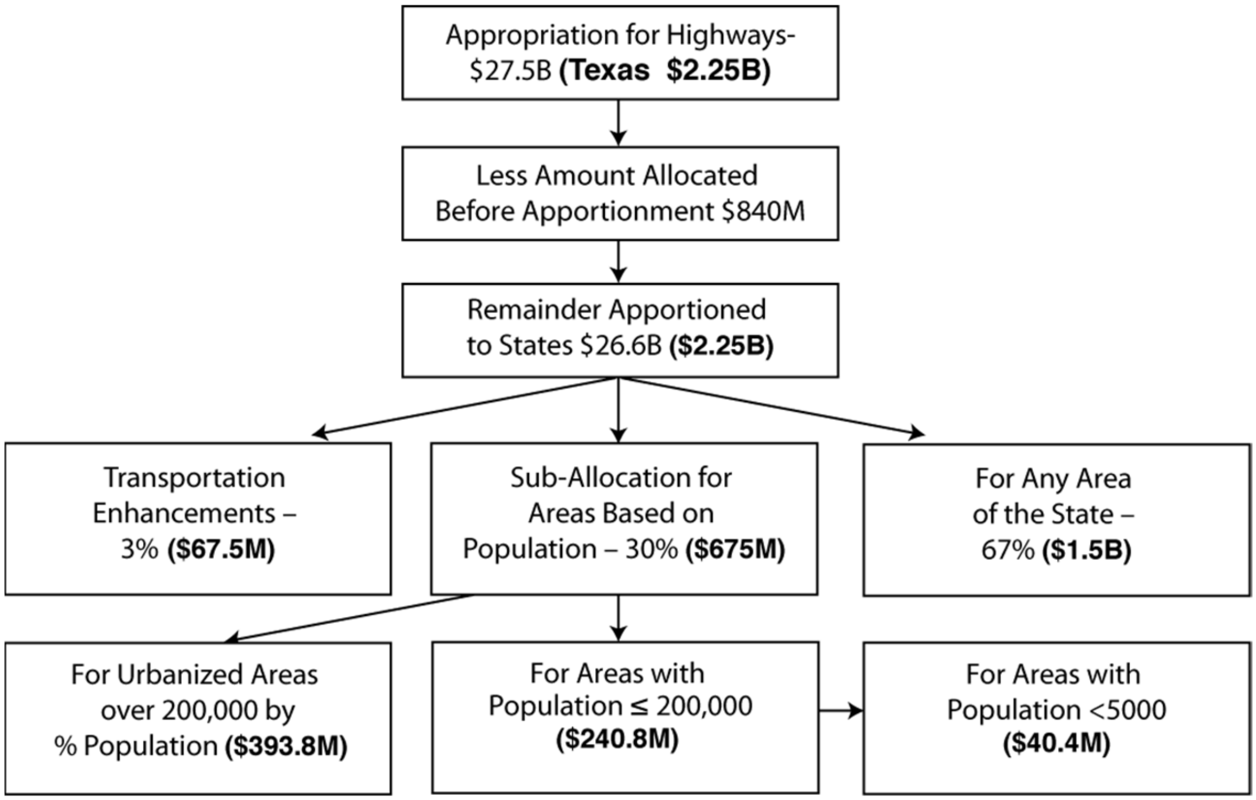
Highway allocation was disappointingly low, given the likelihood of real employment stimulation and the clear benefits of supporting and enhancing the main domestic freight modal system. At 3.4% of the total ARRA obligations, one could argue an opportunity to support all state DOTs facing financial constraints was lost. The distribution of the $48.1 billion within the highway sector is given in Figure 2.2. Over two-thirds of the final apportionment ($26.6 billion) was available to be spent in any area of each state DOT. The allocation to Texas was $2.25 billion, greater than any state other than California.

Instructions for project selection priorities included:

- Projects to be completed by February 17, 2012,
- Expediency, and
- Emphasis on job creation and economic benefits.

In terms of expediency, preference was to be given to projects that could be started and completed without delay, including a goal of obligating at least 50% of the ARRA funds not later than June 17, 2009. Nationally, on September 3, 2009:

- $18.1 billion of the $26.6 billion was obligated (68%).
- 7,103 projects were authorized in the U.S.
- 3,250 projects were under construction and $997 million was expended of the $9.48 billion obligated.
- Generally, bids were coming in below the engineer's estimate for the work at rates between 10 and 40%.



Source: Alonzi, 2009

*Figure 2.2: ARRA Federal and State **(Bold)** Highway Allocations*

One approach to facilitate the accurate estimation of indirect and induced effects is to group the various ARRA projects into coherent types (similar work types, materials, and labor/capital mix). The national project mix in September 2009 was as follows:

- 50%—Resurfacing/preservation
- 17%—Widening
- 6%—New pavement construction
- 5%—Bridge improvement
- 5%—Bridge replacement
- 3%—New bridge construction
- 1.5%—bike/pedestrian and right-of-way

In July 2009, contractors reporting on Texas ARRA projects that were underway identified 4,696 staff under employment, working a total of 215,765 hours over the previous 4 weeks with a payroll of $3.3 million. Mobilization in the highway sector is crucial and more projects will come on stream. As an example of the mobilization "ramp up" effect, Texas ARRA employment in June was just 1,314 staff.

President Obama stated that “every American will be able to hold Washington accountable for these decisions by going online to see how and where their tax dollars are being spent” when he promoted the Act, and a special website was set up for the purpose (Recovery.gov), as shown in Figure 2.3.

Figure 2.3: ARRA website logo

The FHWA identified several “risks” related to ARRA highway projects. These are:

- Local public agency oversight
- Plans, specifications, and estimates quality
- Contract administration
- Quality assurance
- Disadvantaged business enterprise program
- Eligibility/improper payments
- Achievement of program goals

There is every confidence, however, that all the TxDOT projects will meet program goals, including avoiding the risks noted above.

2.4 TxDOT Use of ARRA Funds

2.4.1 Highways & Bridge

Under ARRA, Texas was granted $2.25 billion for construction of highways and bridges. Of that, $1.68 billion was allocated to the Texas Transportation Commission (with a minimum of $175 million to be spent in rural areas), $500 million went to the state’s Metropolitan Planning Organizations (MPOs), while the remaining $67.5 million was allocated for transportation enhancement projects (e.g., hike and bike trails), as shown in Table 2.1.

Table 2.1: TxDOT Use of ARRA Funds as of February 2010

	Highways and Bridges	Transit	Aviation
Funding under ARRA	$2.25 billion	$372 million	Project-specific
Funding received (obligated)	$1,889,389,337	$50,587,402	$17,526,834
Contracts awarded	$1,568,252,406	$50,587,402	$17,526,834
Funding spent (expended)	$368,851,296	$16,801,186	$4,090,087
Number of contracts executed	491	80	6
Number of projects completed	114	0	0

The first 50% of all highway and bridge funding not sub-allocated within the state, approximately $775 million, had to be obligated within 120 days (i.e., by June 30, 2009) and the rest, as well as any sub-allocated funding, had to be obligated within 12 months (by March 1, 2010). Texas met both deadlines. As of February 2010, Texas had obligated $1,889,389,337 for highways and bridges (Mr. John Barton, Testimony before the Select Committee on Federal Economic Stabilization Funding, February 10, 2010).

2.4.2 Transit

For transit, Texas received $371,806,104. Urban recipients will receive $301,055,797, smaller rural recipients will receive $42,181,107, and another $28,569,200 is for cities, using a high growth and high density state formula. Effectively, rural recipients will get about $50 million. The first 50% of all transit funding needed to be obligated by September 1, 2009, and the rest by March 1, 2010. TxDOT met these deadlines deadline for the rural program. To date Texas has obligated $50,587,402.

2.4.3 General Aviation

For aviation, the Federal Aviation Administration received $1.1 billion nationwide in discretionary funds. Texas and other states were required to apply for these funds on a project specific basis. As of February 2010, Texas received funding for six projects. The total amount awarded for those projects is $17,526,834.

2.4.4 Transportation Enhancements

ARRA required TxDOT to spend $67.5 million on transportation enhancement (TE) projects. TxDOT felt that there was not adequate time to go out for a program call and make the selection. Therefore, TxDOT decided to advance several projects that had previously been selected, but had not yet gone to construction. Because those projects were now funded with ARRA dollars, the department went out for a program call with a funding level of the same amount, $67.5 million.

2.4.5 High Speed Intercity Passenger Rail Overview

ARRA funds are also available under the High Speed Intercity Passenger Rail Grant program (HSIPR). Funding for this program comes from two sources: the ARRA and the FY 2009 Appropriations Act. TxDOT submitted nine applications to be considered for these awards and of those, two were awarded funding for a total of approximately $11 million. Of that amount, about $4 million is funded by ARRA, with the remaining $7 million coming from the FY09 appropriations bill. Both of the Texas grant awards directly impact existing passenger rail in the state, allowing existing lines to travel at higher speeds or avoid congestion.

Heartland Flyer Upgrades
TxDOT received about $4 million in HSIPR ARRA funds to adjust signal timing for several at-grade crossings for Amtrak's Heartland Flyer over 63 miles of the BNSF Rail. Changing the signal timing will increase speeds for the Heartland Flyer from 49 MPH to 79 MPH in Texas. Once complete, this project will reduce travel time on the Texas leg by over 15 minutes.

Trinity Rail Express
TxDOT received approximately $7 million from the FY09 appropriations bill to lay additional track along a portion of the Trinity Rail Express (TRE) in Fort Worth. This project will improve commuter rail service between Fort Worth and Dallas. The project will also allow TRE to begin the movement of Amtrak off the Union Pacific (UPRR) Corridor onto the TRE Corridor. Amtrak will still have to move across the UPRR Corridor until the TRE Corridor is double tracked.

2.4.6 Transportation Investment Generating Economic Recovery (TIGER) Grants

ARRA appropriates $1.5 billion nationwide, available through September 30, 2011, for discretionary grants for transportation infrastructure. These grants will be awarded based on the following selection criteria:

- Long-Term Outcomes: Priority to projects that have a significant impact on desirable long-term outcomes for the nation, a metropolitan area, or a region.
- State of Good Repair: Improving the condition of existing transportation facilities and systems, with particular emphasis on projects that minimize life-cycle costs.
- Economic Competitiveness: Contributing to the economic competitiveness of the United States over the medium- to long-term.
- Livability: Improving the quality of living and working environments and the experience for people in communities across the United States.
- Sustainability: Improving energy efficiency, reducing dependence on oil, reducing greenhouse gas emissions, and benefitting the environment.
- Safety: Improving the safety of U.S. transportation facilities and systems.
- Job Creation and Economic Stimulus: Priority to projects that are expected to quickly create and preserve jobs and stimulate rapid increases in economic activity, particularly jobs and activity that benefit economically distressed areas.
- Innovation: Priority to projects that use innovative strategies to pursue the long-term outcomes outlined above.
- Partnership: Priority to projects that demonstrate strong collaboration among a broad range of participants and/or integration of transportation with other public service efforts.

No state will get more than $300 million in TIGER Grants. Each grant shall not be less than $20 million and not greater than $300 million; the USDOT Secretary may waive the $20 million minimum grant size for the purpose of funding significant projects in smaller cities, regions, or States. Not more than 20% of the funds available for TIGER Grants may be awarded to projects in a single state. The federal share of these grants may be up to 100%.

As of September 10, 2009, TxDOT had processed approximately 85 support letters for projects submitted by local governments. TxDOT submitted applications for an additional five projects outside of MPO boundaries that MPOs and other entities could not submit directly, namely:

1. IH 35 in Waco, McClennan County
2. South Orient Rail Line Rehabilitation
3. SH 35 in San Patricio County
4. SH 359 in Midland and Martin Counties, Motran La Entrada Project
5. U.S. 281 in Comal County

2.5 TxDOT ARRA Database

Under Research Task 2, a Microsoft Access database was created to portray project-related data for TxDOT projects funded by ARRA funds. This database was designed to be used by three different groups of users, namely, Administrators, Contractors and the general public. The database can generate customized reports for each particular user group. These customized reports are generated in a format that the research team envisioned would be useful for specific TxDOT applications. A copy of the database was submitted to TxDOT in August 2010.

A demonstration of the database was done at the project close-out meeting on September 23, 2010. During the demonstration, it was discussed that existing reporting systems of TxDOT have similar features with the additional advantage of already being standardized. However, the participants in the meeting recognized that the "User" module of the demo database generated reports in formats that were much more user-friendly for the general public. It was proposed that CTR collaborate with TxDOT on a subsequent project that would isolate and implement the "User" module. This would benefit the general public by generating reports that would be user-friendly and easy to understand.

2.6 State Reporting on ARRA

Task 3 of this research included a review of the ARRA reporting requirements and state DOTs reporting performance.

2.6.1 Federal Reporting Requirements

Each month, the DOTs were required to submit two forms to the FHWA: Forms 1585 and 1587. Form 1585 included the following data items for each project utilizing ARRA funds:

1. Report Month
2. State Project Number or Identification Number
3. Contract Number

4. Contracting Agency
5. Federal-aid Project Number
6. Advertisement Date
7. Award Date
8. Notice to Proceed Date
9. ARRA Funds ($)
10. Total Fund ($)
11. Disadvantage Business Enterprise (DBE) Goal (%)
12. DBE Commitment (%)
13. DBE Actual Payment ($)
14. Project Percent Complete (%)
15. Contractor Name
16. Contractor Address
17. Data Universal Numbering System (DUNS) Number = Unique ID for each Contractor
18. Contractor E-Mail Address

Form 1587 included the following data:

1. Report Month
2. State Project Number
3. Contract Number
4. Federal-aid Project Number
5. Project Description
6. Contractor Name and State/Local Agency
7. Contractor Report Status
8. Total Employees
9. Total Hours
10. Total Payroll($)

The last three items were the essence of the direct labor reporting requirements. Each contractor was required to submit to the DOT the number of 'boots on the ground' employees on site at end of each month, the number of work hours paid, and the payroll amount.

2.6.2 State DOT reporting

When the ARRA was initiated in early 2009, the vast majority of early relief efforts went to tax relief, health care, and education due to the immediacy of these needs and the time required to plan out and program infrastructure investments. For this reason, the summer of 2010 was a prime period of stimulus infrastructure spending where some of the major job-producing construction projects were undertaken. Ironically, the stimulus has faded from the front pages and is no longer the subject of major discussion that it was in 2009. Therefore, it is sometimes the agencies still receiving and implementing stimulus funds, like state DOTs, who are in the best position to provide feedback as to how stimulus funding is being implemented. Most states have retained their ARRA micro-sites, usually including the standard ARRA icon visible from the front page. As new programs like the first and second rounds of TIGER grants have emerged, the ARRA reporting sometimes shares space and attention with other highlighted programs.

State DOT websites were reviewed and evaluated according to the following criteria:

- Ease of access/navigation
- Adequacy of information
- Availability of geographic data
- Information on direct, indirect, and induced labor
- Information on contacts.

In all of the above respects, state DOTs met the standards required by the ARRA. Some websites had additional content.

2.6.3 Review of state DOT websites

Wyoming—The DOT has provided a map of projects around the state. There is a separate map of transit projects. There is a spreadsheet breakdown of all projects with dollar amount but without job estimates, at the following web address:
http://www.wyoming.gov/recovery/Documents/Quick%20Info/WyomingARRAFundingSummary.pdf

Wisconsin—The DOT ARRA link is not visible from the DOT main site. Most information is contained on the Wisconsin state government ARRA site. The breakdown of transportation projects by county does not include job estimates. The job creation estimates use data from the Council of Economic Advisors. Following is the Web address:
http://www.recovery.wisconsin.gov/JobsOverview.aspx.

West Virginia—This site correlates investment and job creation with poverty level by county. It also calculates direct jobs by project, even including projects that created only a fraction of a job.

Vermont—The ARRA project list does not include job impacts. It includes a very basic map of project locations.

Virginia—The tracking sheet shows percent completion but not job impacts by project. Job estimates are not shown in program updates.

Utah—A map of highway projects around the state with icons representing magnitude; however, few details are available as to project characteristics. Several categories have yet to be filled in. Job information is not readily available.

Tennessee—This site includes an FAQ section that details changes in job estimates that have occurred since the start of the stimulus and explains the current methodology. The jobs information page links to a federal website. Following is the web address: http://www.tnrecovery.gov/federalreporting.html.

Pennsylvania—The ARRA icon is not available from the main DOT site. PennDOT has a simple listing of projects with associated funding levels. Job estimates are presented in aggregate form on the main PennDOT website.

Ohio—Stimulus projects are heavily featured on the web site of the Ohio DOT. The site contains recent updates of projects that have led to substantial hiring over the summer construction season. For example, a press release announced that over the month of July, 8335 workers were employed through stimulus highway projects.

Oregon—Information is available through the main state ARRA site. A map tracking projects is almost identical to the one used in Utah. Job creation estimates are not featured.

Oklahoma—Oklahoma has no estimates of job creation on either the ODOT site or the main ARRA site, http://www.ok.gov/recovery/. An email inquiry returned information that 542 jobs had been created in the last month.

North Carolina—This site developed estimates for cumulative labor hours associated with ARRA projects. A summary spreadsheet is linked to detailed monthly breakdowns by project. The site, however, was last updated in January 2010 (as of August 2010).

New Mexico—Breakdowns by agency are used on the main New Mexico ARRA site. In August 2010 the data was current as of March 31st.

New Jersey—This site had, as of August 2010, details of project awards through the end of June without corresponding employment estimates.

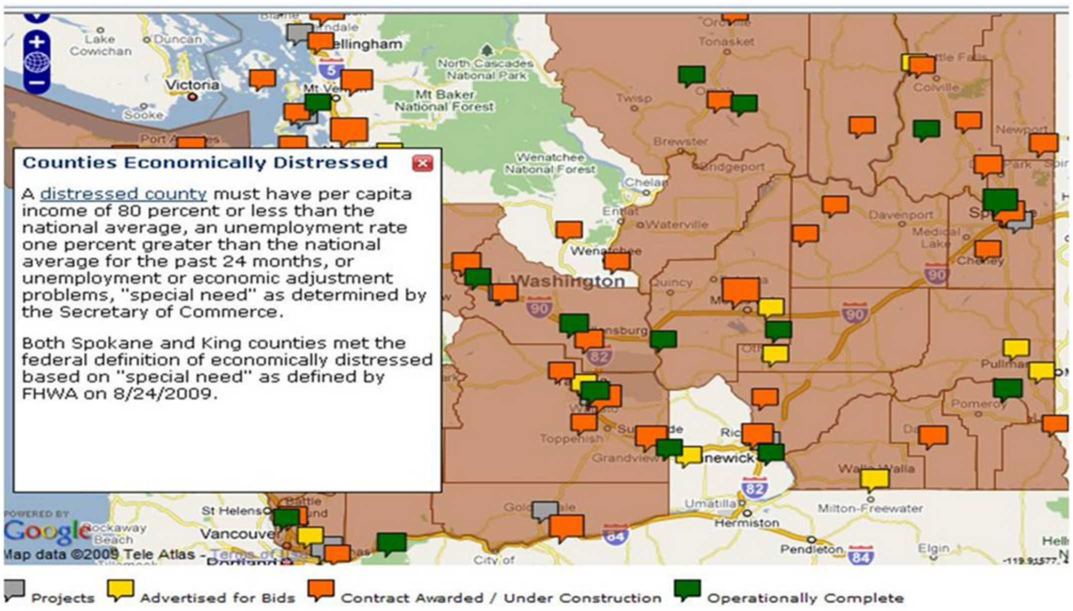
Missouri—This site has a searchable database of jobs impacts by program area and project. The database also contains a comparison of how much money was allocated to each project and what percentage has been received to date.

Mississippi—An interactive map breaks down projects by location and program, with transportation as a distinct program. The data includes dollars allocated and jobs created. It does not indicate how job totals are calculated or the extent to which projects have been completed.

Indiana—Reports on lettings principally are included for 2009. A GIS map for transportation projects is unique in that it includes the full length of the affected corridors, not merely a single point location.

Georgia—Grants for transportation are divided into the categories of Airports, Highways, and Transit with associated jobs impacts.

Washington State—Washington State DOT (WSDOT) provided a map showing the locations of ARRA projects and which counties qualified as economically distressed, as shown in Figure 2.4. As of the end of August, it had not been updated since March 2010. WSDOT also provided a table of ARRA projects and total estimated job impacts, as shown in Figure 2.5. The method of computation of indirect and induced employment was not specified.



Source: http://www.wsdot.wa.gov/funding/stimulus/map/

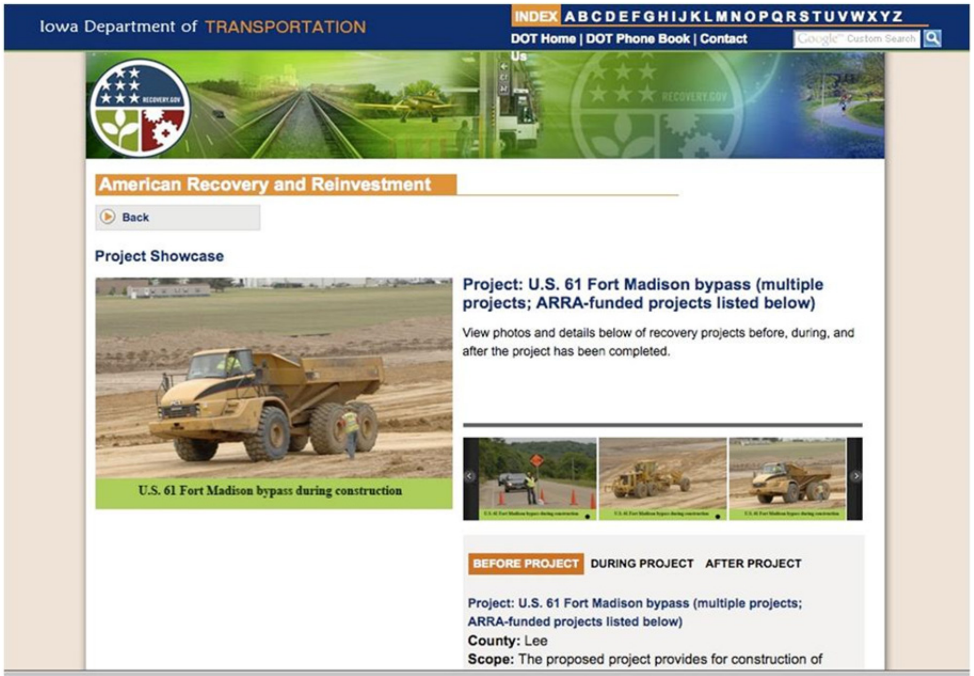
Figure 2.4: Washington State DOT Website showing ARRA projects

Active Project	WSDOT Recovery Act Projects	Total Funding	Estimated Impact: Direct, Indirect, & Induced Jobs
	I-405/NE 195th St to SR 527 - NB Widening	$50,987,267	345
	I-405/NE 8th St to SR 520 Braided Ramps - Interchange Improvements	$278,577,524	925
	I-5/Marysville to Stillaguamish River - ITS	$2,551,021	15
	I-5/North Kelso to Castle Rock Stage 2 - Concrete Pavement Rehab	$8,270,195	55
	I-5/Port of Tacoma Rd to King Co Line - Add HOV Lanes	$75,745,304	285
	I-5/SR 16/EB Nalley Valley - Add HOV	$106,817,168	625
	I-5/SR 501 Ridgefield Interchange - Rebuild Interchange	$30,000,000	195
X	I-5/SR 532 Vic to Starbird Road Vic - Concrete Rehab	$9,200,000	45
X	I-82/Valley Mall Blvd Interchange - Rebuild Interchange	$38,555,063	165
X	I-90/Lake Easton Vic to Big Creek Br Vic EB - Replace/Rehab Concrete	$23,482,143	120
X	I-90/Lake Easton Vic to Bullfrog Rd I/C Vic WB - Replace Concrete	$21,622,449	125
X	SR 433/Lewis and Clark Bridge - Superstructure Painting	$50,000,000	230
These project estimates are based on financial information provided 5/28/09, and reflect refined project estimates. As such, some figures are lower than initial projections.			

Source: http://www.wsdot.wa.gov/Funding/stimulus/jobs.htm

Figure 2.5: WSDOT display of ARRA projects funded and total estimated job impacts

Iowa—The Iowa DOT gave photo updates on ARRA projects, as illustrated in Figure 2.6.



Source: http://www.iowadot.gov/recovery/projectshowcase/US61FortMadisonBypass.htm

Figure 2.6: Iowa DOT ARRA website content

2.6.1 State DOT Interviews

Selected State DOT officials were interviewed on their ARRA estimating and reporting functions. Some states retain staff specifically charged with liaising on ARRA projects.

Peter Freer—Alaska

In the Alaska DOT, they have assigned a single individual, Peter Freer, to be responsible for compiling all the information submitted by the contractors on how many workers participated in ARRA-sponsored projects. This is a full-time job he received as a two-year special assignment in 2009.

Regarding job impacts, Mr. Freer stated that the estimates become tricky when the projects are jointly funded by the ARRA and other sources. He estimates the number of labor hours that were funded by the ARRA, from which one could derive full-time employees (FTEs) and also the number of workers who have been employed in some capacity by an ARRA project. Furthermore, he says that the federal government has never requested that this information be placed on their website.

Charles Meyer—Colorado

Colorado DOT (CDOT) had experienced some confusion early on in estimating job impact numbers. Charles Meyer, a Civil Engineer at CDOT, was charged with managing job impact numbers. The biggest issue was in avoiding double counting in which jobs would be counted as new in subsequent reporting periods even if they were actually reported previously. In the last few months they have greater confidence in the numbers (Table 2.2). It is very difficult to go back and compare recent reporting periods with earlier periods.

The job impact estimations within Colorado have gained new relevance as the Colorado State House has discussed starting its own infrastructure stimulus program that would require job impact estimates to be performed. Under the current stimulus legislation, CDOT relies on the federal government to produce indirect and induced job figures tied to Colorado; however, for a state-led initiative CDOT would need to estimate these figures directly. For this reason, CDOT is currently examining strategies for indirect and induced job impact measurement.

Table 2.2: Colorado ARRA Transportation Spending and Job Estimates—Highway and Transit—as of June 30, 2010

Projects put to bid	Number	Dollars
Projects under contract	127	$399,423,688
Projects under construction	122	$393,770,713
Projects complete	113	$379,541,785
No. of Direct jobs	29,074	
Direct job hours	1,534,129	
Direct labor payroll		$42,285,229

Tracy Clark—Arizona

Arizona has an extensive website demonstrating the impact of ARRA projects around the state along with a detailed interactive map. The Arizona DOT hired an economist, Tracy Clark, who had formerly worked for 20 years at Arizona State University, to head up the economic impact estimates. Mr. Clark knew a great deal about input-output models but had to quickly familiarize himself with the transportation terminology. He expressed frustration in the way the data was being compiled and presented as he says it doesn't include indirect and induced employment and thereby understates the real impact of the stimulus. Although he would like to broaden the analysis, he only has data to calculate direct impacts and even this data is not as rich as would be desired. Most of the employment data is not on the website; however, he provided a spreadsheet that shows the breakdown of employment by county. This is for stimulus grants to all agencies, however, not only for the DOT.

Jake Bleed—Arkansas

Arkansas did not explicitly report job creation estimates on their ARRA website. Jake Bleed at the Arkansas Department of Finance and Administration provided the researchers with a spreadsheet detailing job creation by project for the quarter ending 06/30/10 (Table 2.3).

Table 2.3: Arkansas ARRA Job Estimates by Quarter—Highway Projects Only

Quarter	End Date	Jobs in Quarter
Q3, 2009	9/30/2009	387.54
Q4, 2009	12/31/2009	184.39
Q1, 2010	3/31/2010	262.69
Q2, 2010	6/30/2010	313.55

<u>John Barton—Texas</u>
The infusion of funds from ARRA allowed the construction industry to keep people employed. Through the end of 2009, Texas contractors reported over 2,202,578 payroll hours for workers working on projects funded with ARRA dollars. This translates to approximately 4,000 FTEs. The FTE number is derived by a formula given to states from the Federal Highway Administration and does not depict actual people on a payroll, so actual persons with jobs could be much higher. These figures mostly represent workers who have been working on smaller scale maintenance projects that were able to be started quickly. Texas put a sizeable portion of its ARRA allocation on larger scale mobility projects. These projects are just starting, and will provide jobs for as long as 3 years. TxDOT also took steps to require contractors to provide on-the-job training of all of the workers, thus creating skilled workers for the future. This was not required under ARRA, but it was something that TxDOT believed was important.

2.7 Chapter Conclusion

From the information gathered from interviews and reviews of websites, a number of trends emerge. The first is that states are still dutifully reporting their spending on ARRA projects with specific attention to projects that have been completed or nearing completion. After significant confusion amongst states as to how to report job creation figures early on, some states have refined their reporting while others seem to have dropped the effort—at least on their public website. Investment by region is now featured more prominently than are job creation figures. As other programs such as the TIGER Grant program have emerged, they have begun to push aside the original ARRA information.

It would appear that job creation numbers were a priority for the federal government in making the case for the stimulus effort, yet state agencies feel more comfortable reporting dollar figures and allowing federal analysts to gauge the impact on employment. As the bulk of projects wind down over the next year, job numbers will likely become even less of a priority with most of the focus shifting to convincing the public that the stimulus money has been used efficiently and has been successful in delivering priority infrastructure projects for the public benefit.

Chapter 3. Analysis of Direct Labor Usage on ARRA Projects

3.1 Data Analyzed

This chapter gives the results of an analysis of direct labor used on TxDOT ARRA projects as of December 2009. Direct labor usage figures recorded on TxDOT ARRA projects completed between May and November 2009 were obtained from TxDOT's Construction Division. Table 3.1 is a summary of the projects. Total Funds is the sum of contract award amounts.

Table 3.1: Summary of TxDOT ARRA contracts completed May–November 2009

Project Type Code	Project Type Description	No of Projects	Total Funds
BR	Bridge Replacement	1	$313,362
MSC	Miscellaneous Construction	4	$1,745,232
OV	Overlay	29	$32,552,127
RER	Rehabilitation of Existing Road	2	$1,552,061
RES	Restoration	1	$788,365
SC	Seal Coat	2	$1,615,577
Total		**39**	**$38,566,724**

Clearly, only projects with short construction durations would have been completed in the period. Thus, pavement maintenance projects comprise the majority of the projects. No projects adding capacity to the system were completed in the period.

3.1.1 Objective Variables

The variables of interest regarding direct labor usage are total hours worked and total labor payroll. Table 3.2 is a summary of the objective totals for the 39 projects.

Table 3.2: Total hours worked and payroll for 39 TxDOT ARRA projects

Project Type	Total Funds	TxDOT District	Hours Worked	Payroll
BR	$ 313,362	Houston	5,443.5	$ 74,526
MSC	$ 118,220	Houston	1,224.0	$ 29,824
MSC	$ 61,344	Tyler	1,067.0	$ 14,726
MSC	$ 743,781	Houston	1,900.0	$ 29,006
MSC	$ 821,886	Houston	2,238.0	$ 38,956
OV	$ 4,997,460	Abilene	13,908.0	$ 202,759
OV	$ 1,118,222	Houston	2,422.0	$ 36,716
OV	$ 1,366,894	Amarillo	4,352.0	$ 62,651
OV	$ 1,256,628	Childress	2,370.8	$ 30,844
OV	$ 2,844,588	Yoakum	11,753.2	$ 176,071
OV	$ 1,766,929	Tyler	2,513.0	$ 37,253
OV	$ 653,888	Houston	2,366.0	$ 35,698
OV	$ 567,067	Yoakum	2,154.0	$ 32,952
OV	$ 1,795,188	Tyler	8,961.0	$ 129,158
OV	$ 2,393,603	Beaumont	9,180.5	$ 170,343
OV	$ 1,345,918	Austin	8,056.0	$ 173,624
OV	$ 814,457	Beaumont	2,123.0	$ 33,360
OV	$ 610,453	Austin	3,143.8	$ 46,518
OV	$ 684,659	Corpus Christi	2,502.0	$ 41,756
OV	$ 292,811	Austin	2,140.0	$ 33,584
OV	$ 820,343	Corpus Christi	3,259.8	$ 53,568
OV	$ 646,223	Houston	2,214.0	$ 33,129
OV	$ 813,244	Beaumont	3,550.0	$ 54,353
OV	$ 1,833,527	Fort Worth	7,742.5	$ 101,312
OV	$ 654,828	Houston	1,760.0	$ 25,410
OV	$ 328,245	Austin	2,245.5	$ 30,803
OV	$ 662,733	Fort Worth	1,867.0	$ 44,476
OV	$ 383,159	Beaumont	1,594.0	$ 21,461
OV	$ 525,420	Beaumont	3,618.0	$ 51,860
OV	$ 1,444,444	Austin	9,100.5	$ 132,779
OV	$ 301,864	Austin	1,785.0	$ 27,197
OV	$ 366,817	Houston	3,232.0	$ 55,973
OV	$ 1,054,970	Austin	7,110.5	$ 113,637
OV	$ 207,545	Houston	619.0	$ 8,410
RER	$ 955,283	Yoakum	6,593.8	$ 108,067
RER	$ 596,778	El Paso	2,280.0	$ 29,274
RES	$ 788,365	Wichita Falls	2,578.5	$ 35,635
SC	$ 1,045,215	Austin	2,821.0	$ 37,992
SC	$ 570,363	Austin	1,862.5	$ 30,269
		Totals	**155,651.3**	**$2,425,930**

Out of a total of about $38.6 million spent for construction of these 39 projects, total payroll is just about 6.3%, with labor rates averaging $15.59 per hour.

3.1.2 Data Exploration

It is expected that total hours worked and total labor payroll have some statistical relationship to project size, complexity, and location. Total Funds (contract amount), a continuous variable, may serve as a surrogate for project size. Project complexity may be represented by the categorical variable Project Type, and location by the categorical variable District. The following two figures (Figure 3.1 and 3.2) are plots of Hours Worked and Payroll versus Total Funds for the 39 projects.

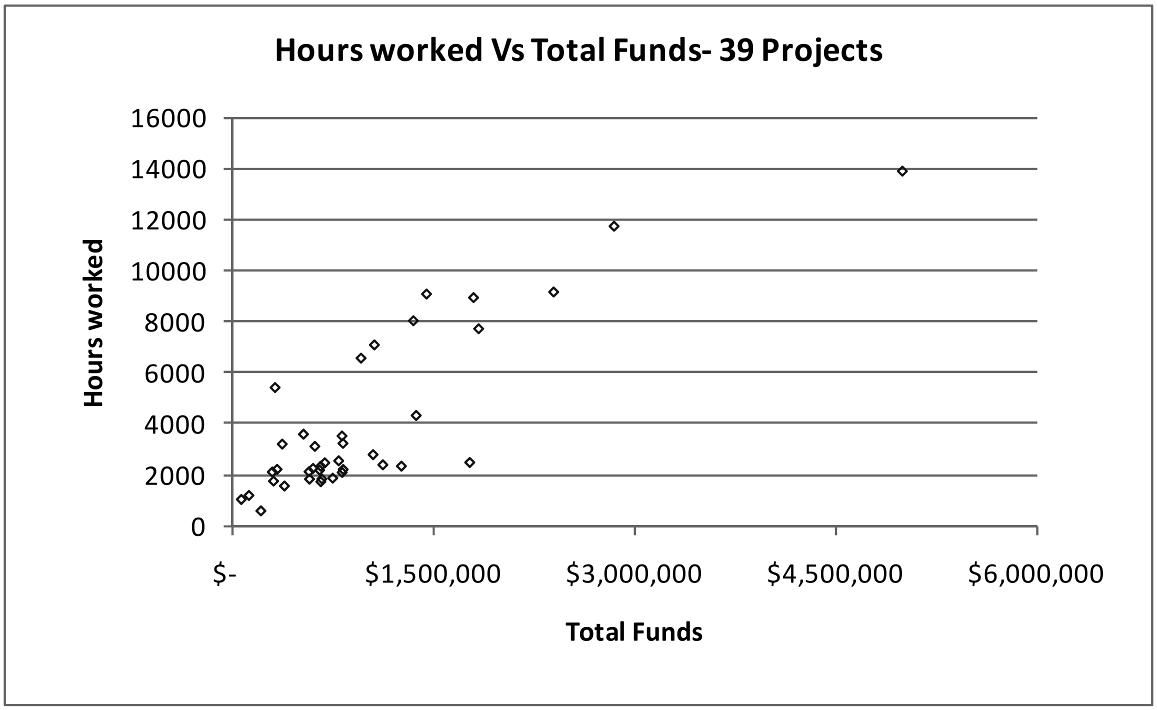


Figure 3.1: Hours Worked versus Total Funds—39 TxDOT ARRA Projects

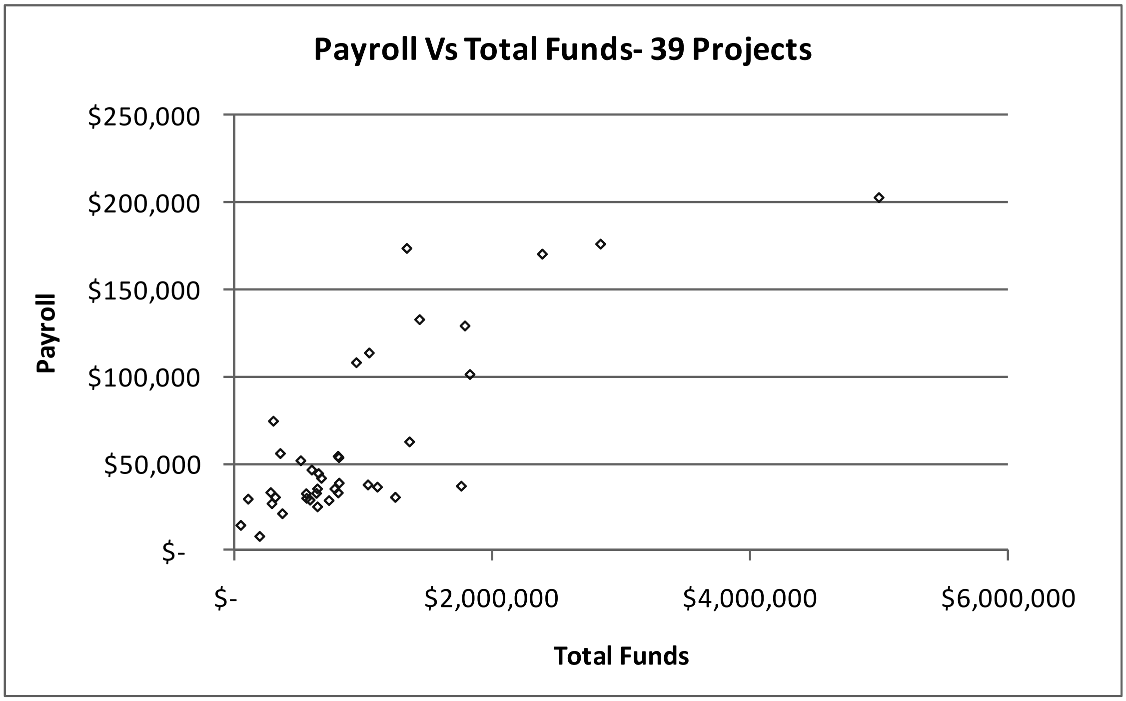


Figure 3.2: Payroll versus Total Funds—39 TxDOT ARRA Projects

Visual inspection suggests that there is a relationship, but whether linear or otherwise is not clear. The next two charts (Figures 3.3 and 3.4) are plotted on a logarithm (base 10) scale.

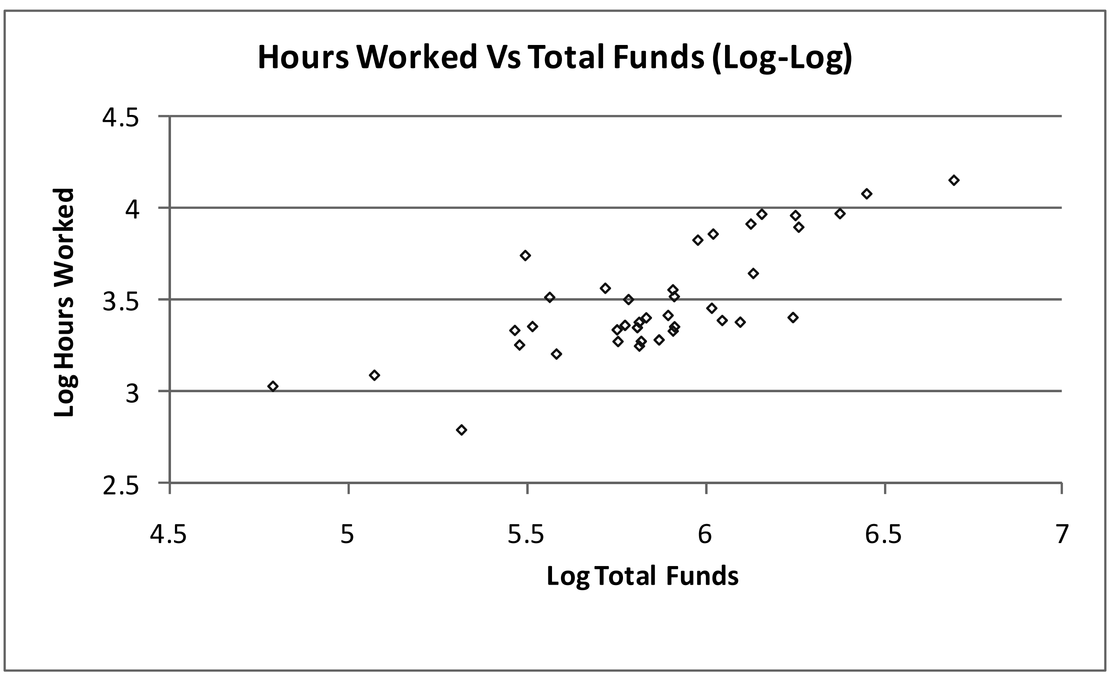


Figure 3.3: Hours Worked versus Total Funds—Logarithmic Scale

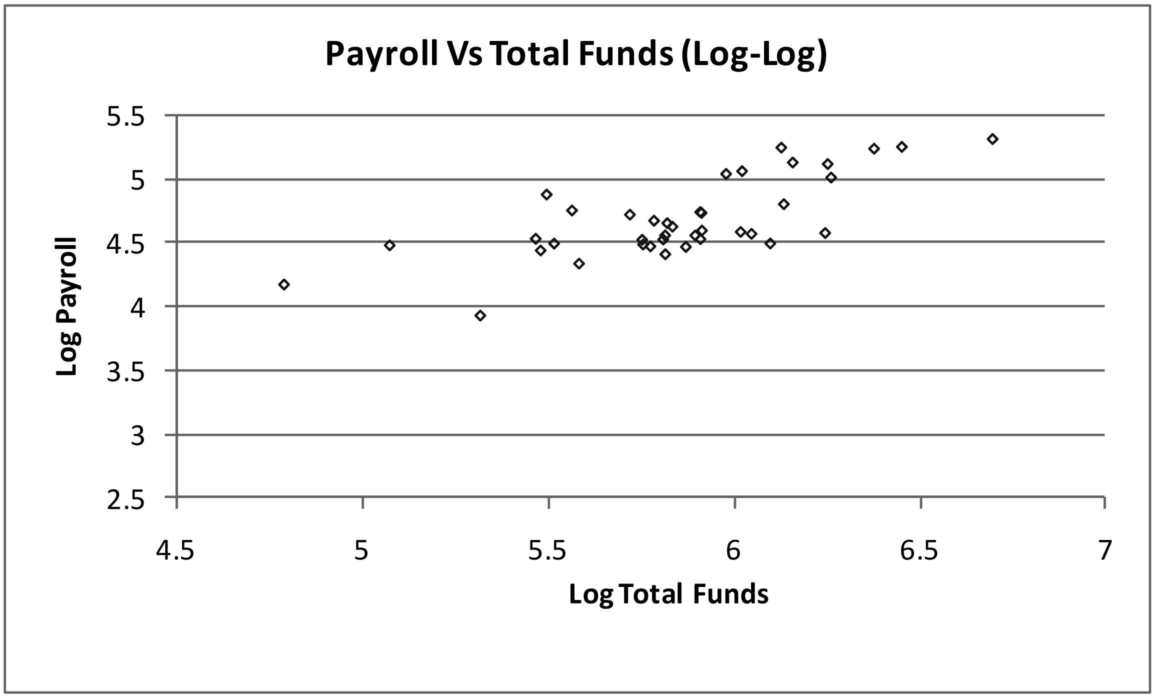


Figure 3.4: Payroll versus Total Funds—Logarithmic Scale

These charts suggest that a logarithmic relationship may exist.

3.2 Analysis

Regression can be used to estimate the parameters of the relationship between the objective variables and the predictor variables. It is postulated that the relationship is of the form:

Log (Hours Worked or Payroll) = A + B*Log (Total Funds) + Project Type Factor + District Factor

where Log is the base 10 logarithm of the respective numbers, A is the estimated line intercept, and B is the estimated line slope. If project type and district are evaluated as switch variables (value 1 when a specific project type or district is present, 0 otherwise), then a different intercept can be computed for each project type and district. Similarly, interaction terms [i.e., each switch variable multiplied by Log (Total Funds)] can also be evaluated to determine if there is a different line slope for each categorical variable.

Stepwise regression in the statistical software package SPSS is used to estimate the parameters. In this method, a threshold is established for any variable to be entered for computation, and another is established for any one to be rejected. For this analysis, a 0.05 p-value (level of significance) is the entry threshold, and a 0.10 p-value is the rejection level.

3.2.1 Initial results—Hours Worked

Regression gave the following result for Hours Worked (Table 3.3):

Table 3.3: SPSS Result for Log (Hours Worked)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.246	.517		-.476	.637
	TOTAL FUNDS	.638	.088	.766	7.240	.000
2	(Constant)	-.470	.487		-.966	.340
	TOTAL FUNDS	.674	.083	.809	8.143	.000
	BRFUNDS	.091	.034	.264	2.663	.012
3	(Constant)	-.177	.482		-.367	.716
	TOTAL FUNDS	.630	.081	.756	7.750	.000
	BRFUNDS	.108	.034	.313	3.226	.003
	HoustonFunds	-.026	.012	-.218	-2.181	.036

This result indicates that Log(Total Funds) is the first variable entered, followed by interaction terms BRLogFunds, then HoustonLogFunds. No other variables make the threshold. The intercept is never statistically significant. The resulting model can be written as:

Log (Hours Worked) = -0.177 + 0.630*Log (Total Funds) + 0.108*BRLogFunds - 0.026*HoustonLogFunds

It can be interpreted as follows: For non-BR projects and non-Houston projects,

Log (Hours Worked) = -0.177 + 0.630*Log (Total Funds)

Or: **Hours Worked = 0.665*(Total Funds)$^{0.63}$**

For Houston non-BR projects,

Log (Hours Worked) = -0.177 + 0.604*Log (Total Funds)

For the single BR project, which happens to be in Houston:

Log (Hours Worked) = -0.177 + 0.712*Log (Total Funds)

The model statistics are given next, in Table 3.4.

Table 3.4: Statistics—SPSS Result for Log (Hours Worked)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.766	.586	.575	.197928986112979	.586	52.415	1	37	.000
2	.809	.654	.635	.183410127511343	.068	7.090	1	36	.012
3	.834	.696	.670	.174531314695967	.041	4.756	1	35	.036

Even though the adjusted R-square (a measure of how much of the objective variance is explained by the model) at the final step is relatively good at 0.670, the standard error is over 0.174. Thus, for a 95% confidence range on the estimate, the point estimate of Hours Worked would be divided and multiplied respectively by approximately 10^0.35 = 2.24.

The next two figures (Figures 3.5 and 3.6) give the fitted lines as estimated by the model.

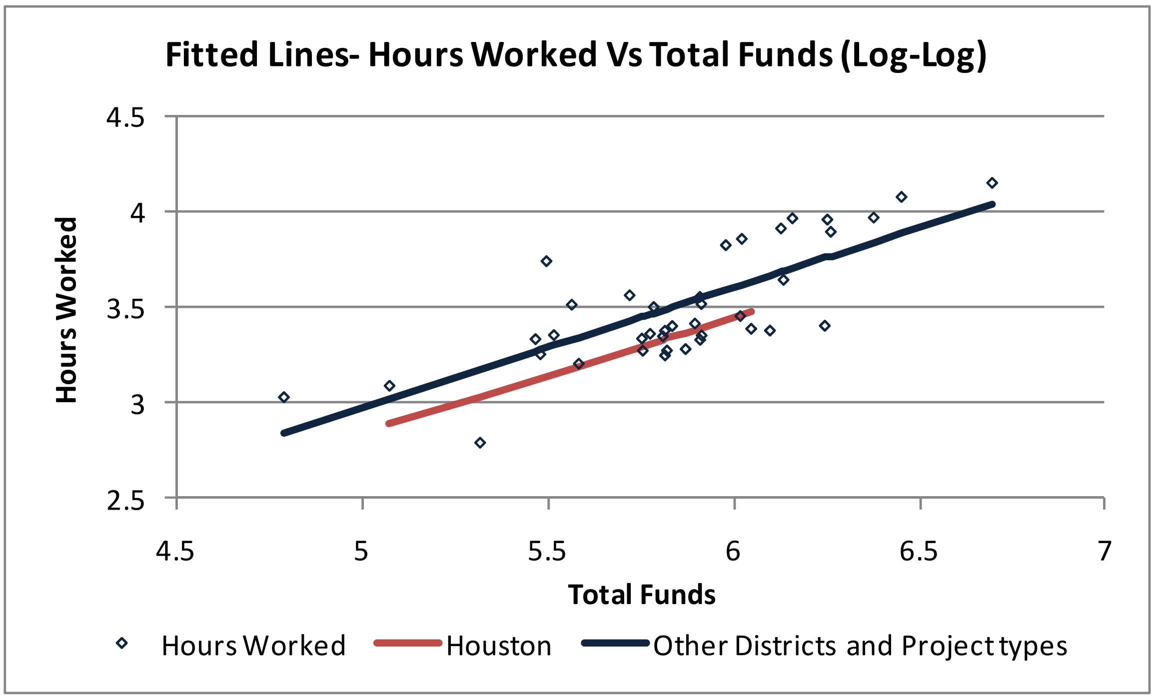


Figure 3.5: Fitted Line for Hours Worked versus Total Funds—Logarithmic Scale

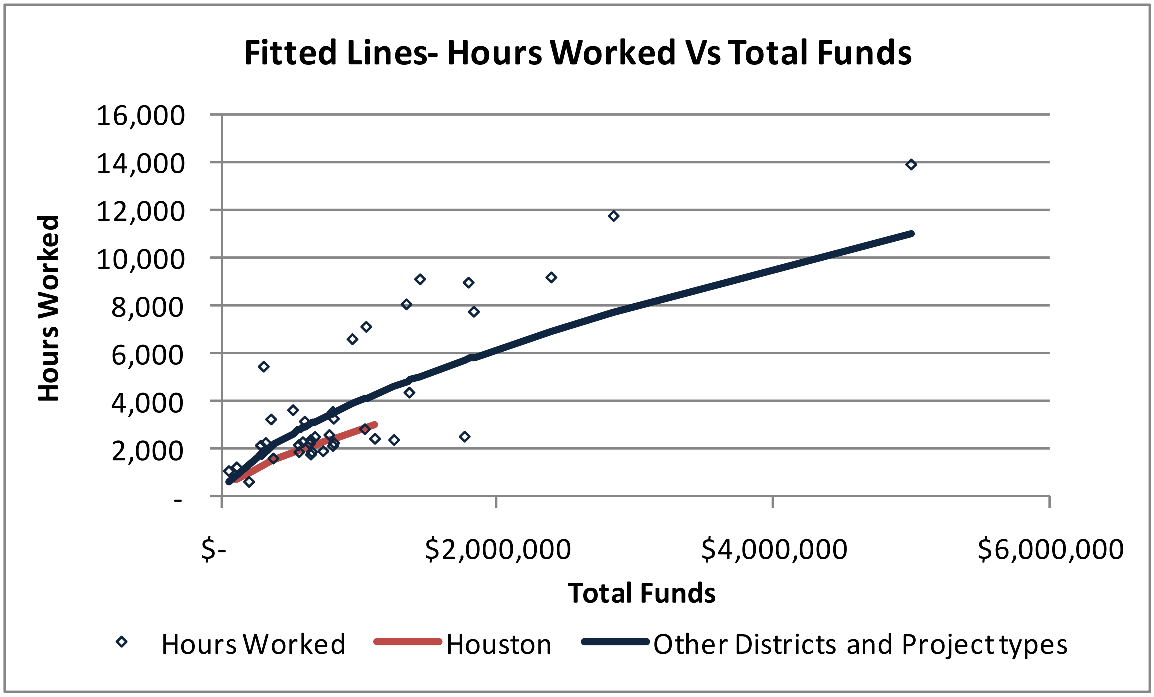


Figure 3.6: Fitted Line for Hours Worked versus Total Funds

It is seen that the fitted line appears to underestimate the Hours Worked on bigger dollar projects due to the influence of many smaller dollar projects.

3.2.2 Initial results—Payroll

Regression gave the following result for Payroll (Table 3.5):

Table 3.5: SPSS Result for Log (Payroll)

		Unstandardized Coefficients		Standardized Coefficients		
Model #		B	Std. Error	Beta	t	Sig.
2	(Constant)	.817	.543		1.507	.141
	TOTAL FUNDS	.657	.092	.771	7.123	.000
	BRFUNDS	.080	.038	.228	2.106	.042

This result indicates that Log(Total Funds) is the first variable entered, followed by BRLogFunds. No other variables make the threshold. The intercept is not statistically significant. The resulting model can be written as:

Log (Payroll) = 0.817 + 0.657*Log (Total Funds) + 0.080*BRLogFunds

It can be interpreted as follows:

For non-BR projects,

Log (Payroll) = 0.817 + 0.657*Log (Total Funds)

Or: **Payroll = 6.5615*(Total Funds)$^{0.657}$**

For the single BR project,

Log (Payroll) = 0.817 + 0.737*Log (Total Funds)

The model statistics are given next (Table 3.6).

Table 3.6: Statistics—SPSS Result for Log (Payroll)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.734	.539	.526	.21375820302009	.539	43.199	1	37	.000
2	.768	.589	.566	.20447738176595	.051	4.435	1	36	.042

The adjusted R-square at the final step is only 0.566, and the standard error is over 0.2044. Thus, for a 95% confidence range on the estimate, the point estimate would be divided and multiplied by 10^0.41 = 2.57. The next two figures (Figures 3.7 and 3.8) give the fitted lines for the model.

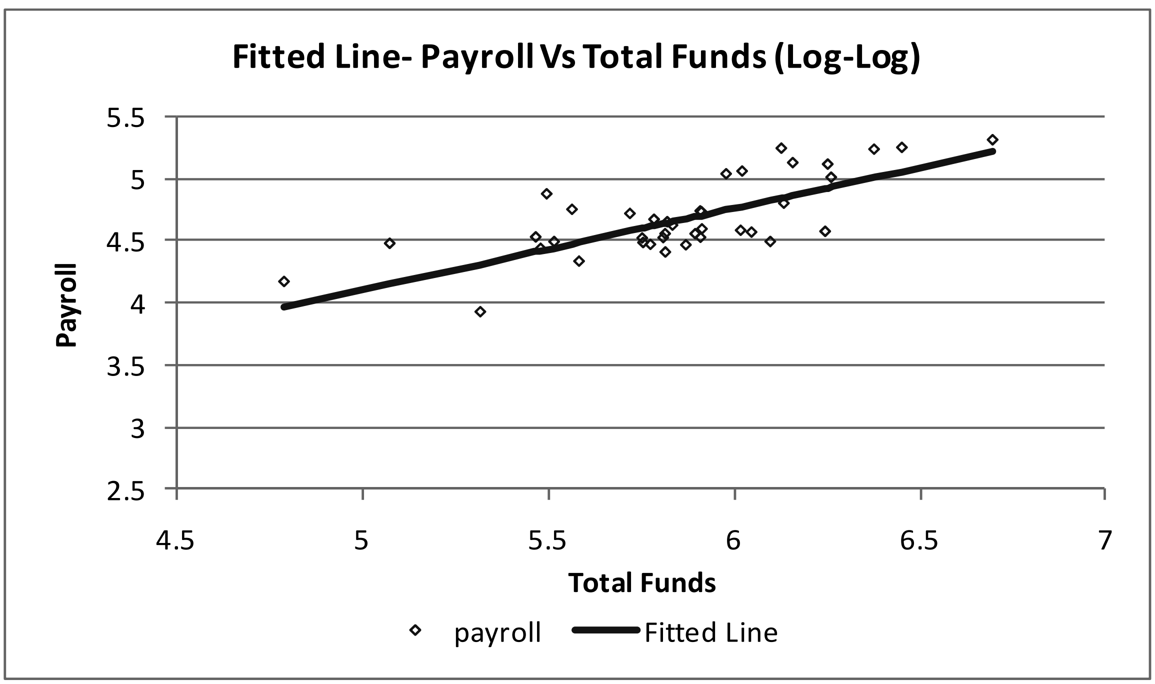


Figure 3.7: Fitted Line for Payroll versus Total Funds—Logarithmic Scale

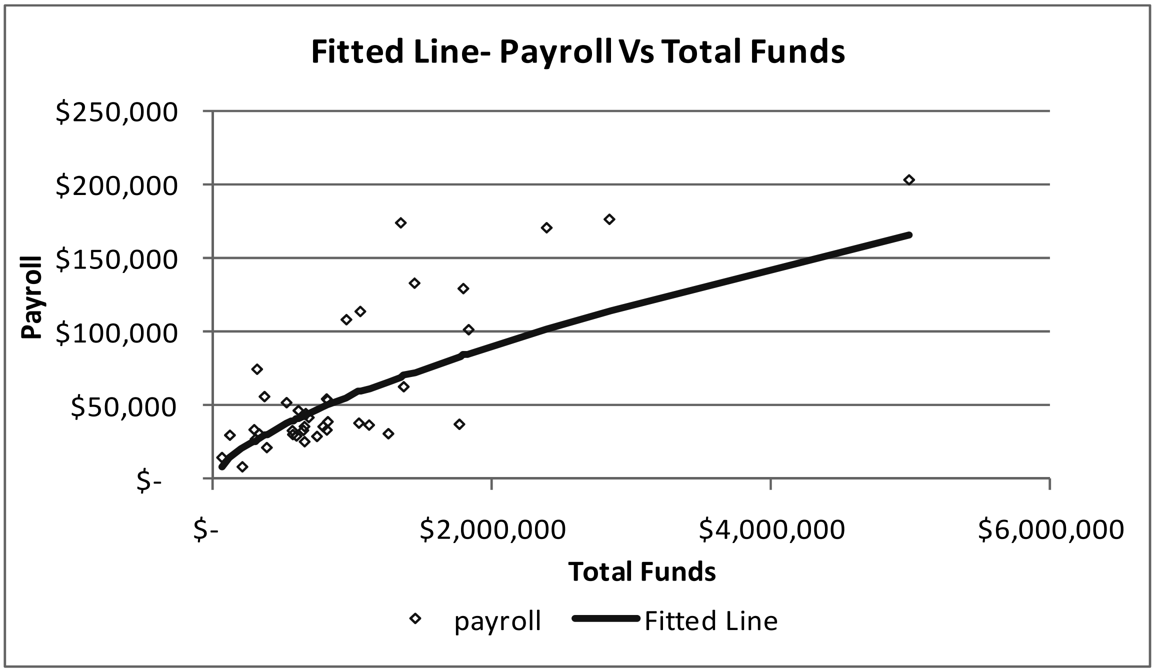


Figure 3.8: Fitted Line for Payroll versus Total Funds

It is seen that, as with Total Hours, the fitted line appears to underestimate the Payroll on bigger-dollar projects due to the influence of many smaller-dollar projects.

3.2.3 Untransformed data—Hours Worked

Because the regression results using the logarithmic transform appear to underestimate Hours Worked and Payroll for bigger-dollar projects, a second set of analyses was performed using untransformed numbers. The following is the result for Hours Worked (Table 3.7):

Table 3.7: SPSS Result for Hours Worked

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
5	(Constant)	587.760	311.454		1.887	.068
	Total Funds	.003	.000	.797	12.146	.000
	AustinFunds	.003	.001	.352	5.157	.000
	BR	3971.293	1240.507	.200	3.201	.003
	SCFUNDS	-.004	.001	-.209	-3.083	.004
	YoakumFunds	.001	.000	.197	3.001	.005

The models are listed in the order that the variables enter. No other variables make the threshold. The intercept is almost statistically significant. The resulting model can be written as:

Hours Worked = 587.8 + 0.003* TotalFunds + 3971.3*BR - 0.004*SCFunds + 0.003*AustinFunds + 0.001*YoakumFunds

It can be interpreted as follows: For non-BR nor SC projects not in Austin or Yoakum,

Hours Worked = 587.8 + 0.003* Total Funds

For the single BR project (which was in Houston),

Hours Worked = 4559.1 + 0.003* Total Funds

For SC (Seal Coat) projects,

Hours Worked = 587.8 - 0.001* Total Funds

Austin and Yoakum have higher slopes. The model statistics are given next, in Table 3.8.

Table 3.8: Statistics—SPSS Result for Hours Worked

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.842	.710	.702	1.732530716386467E3	.710	90.400	1	37	.000
2	.873	.763	.750	1.587078111140164E3	.053	8.093	1	36	.007
3	.896	.802	.785	1.469432053331983E3	.039	6.995	1	35	.012
4	.916	.839	.820	1.346731862966981E3	.036	7.668	1	34	.009
5	.935	.873	.854	1.211579269402006E3	.035	9.009	1	33	.005

The adjusted R-square at the final step is quite good at 0.854, and the standard error is 1211.6. Thus, for a 95% confidence range on the estimate, the point estimate of Hours Worked would be adjusted by +/- 2423 hours. This number is still quite high. The next figure (Figure 3.9) gives the fitted lines as estimated by the model.

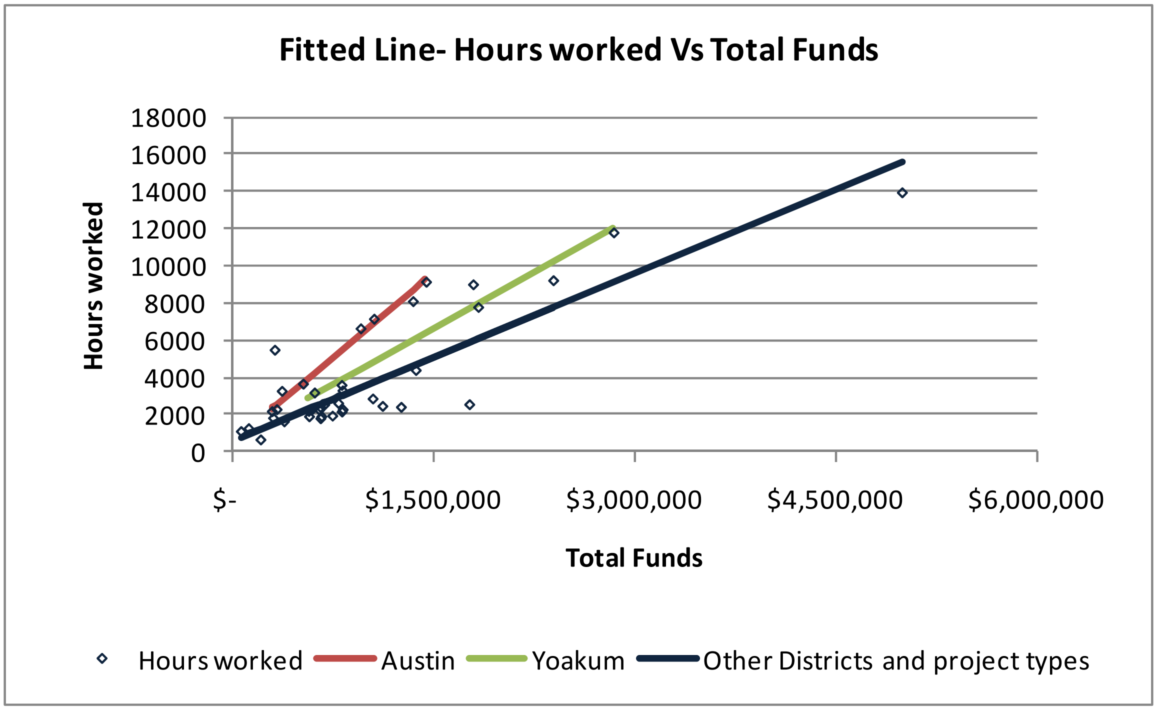


Figure 3.9: Fitted Line for Hours Worked versus Total Funds

It is seen that the fitted lines appear to adequately estimate the Hours Worked on bigger dollar projects, but may overestimate on smaller dollar projects.

3.2.4 Untransformed data—Payroll

Regression gave the following result for Payroll (Table 3.9):

Table 3.9: SPSS Result for Payroll

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
6	(Constant)	8307.691	5120.188		1.623	.115
	Total Funds	.040	.004	.703	10.189	.000
	AustinFunds	.059	.009	.456	6.424	.000
	SCFUNDS	-.068	.019	-.253	-3.630	.001
	YoakumFunds	.023	.007	.222	3.262	.003
	BeaumontFunds	.024	.008	.200	3.013	.005
	BR	53799.380	20288.964	.171	2.652	.012

The variables are listed in the order of entry. No other variables make the threshold. The intercept is not statistically significant. The resulting model can be written as:

Payroll = $8,308 + 0.040* TotalFunds + 53,799*BR - 0.068*SCFunds + 0.059*AustinFunds + 0.023*YoakumFunds + 0.024*Beaumont

It can be interpreted as follows: For non-BR nor SC projects not in Austin, Yoakum, or Beaumont:

Payroll = $8,308 + 0.040* Total Funds

For the single BR project (which was in Houston),

Payroll = $62,107 + 0.003* Total Funds

For SC (Seal Coat) projects,

Payroll = $8,308 - 0.028* Total Funds

Austin, Yoakum, and Beaumont have higher slopes.

The model statistics are given next (Table 3.10).

Table 3.10: Statistics—SPSS Result for Payroll

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.799	.638	.628	$30,757.103	.638	65.278	1	37	.000
2	.849	.721	.706	$27,378.844	.083	10.694	1	36	.002
3	.881	.776	.756	$24,902.470	.055	8.516	1	35	.006
4	.899	.808	.785	$23,399.407	.032	5.641	1	34	.023
5	.918	.842	.818	$21,533.072	.034	7.149	1	33	.012
6	.933	.870	.846	$19,799.605	.028	7.031	1	32	.012

The adjusted R-square at the final step is 0.846, and the standard error is $19,800. Thus, for a 95% confidence range on the estimate, the point estimate of Payroll would be adjusted by +/- $39,600.

The next figure (Figure 3.10) gives the fitted lines as estimated by the model.

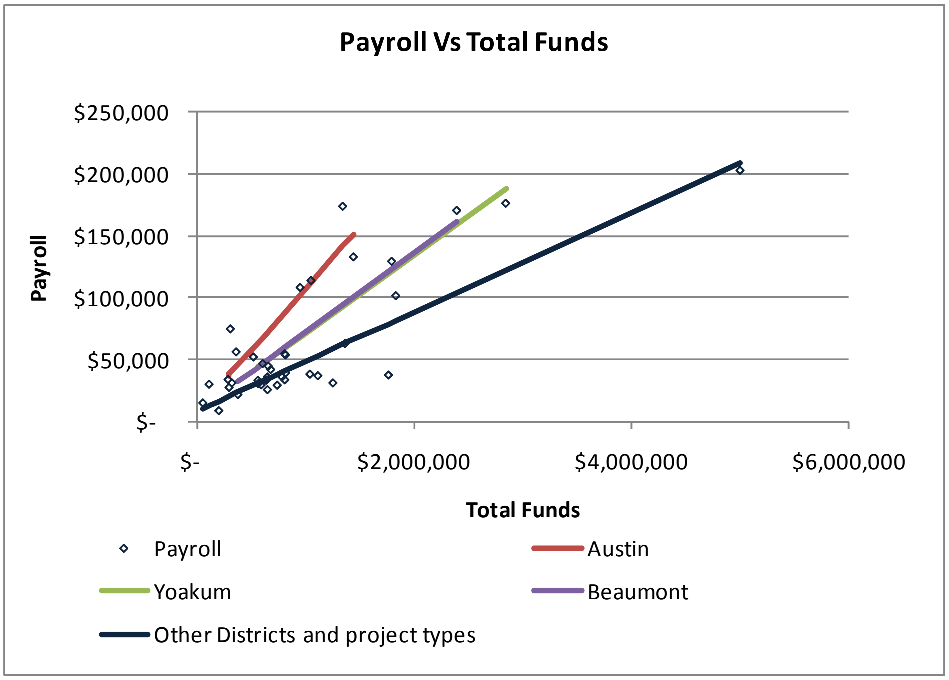


Figure 3.10: Fitted Line for Payroll versus Total Funds

It is seen that the fitted lines appear to adequately estimate the Payroll on bigger dollar projects, but may overestimate on smaller dollar projects.

3.2.5 Hours Worked per dollar Total Funds

Because the estimate error is a constant, it has a greater effect on smaller dollar projects than on larger ones. A third set of analyses was performed using objective values per dollar of Total Funds. Table 3.11 gives the result for Hours Worked per dollar Total Funds:

Table 3.11: SPSS Result for Hours Worked per dollar Total Funds

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	.004	.000		11.842	.000
	BR	.014	.002	.617	8.139	.000
	MSC	.012	.001	1.015	8.608	.000
	MSCCONT	-1.645E-8	.000	-.823	-7.038	.000
	Austin	.002	.001	.300	3.538	.001
	SC	-.003	.001	-.213	-2.557	.015

The models are listed in the order that the variables enter. No other variables make the threshold. The intercept is almost statistically significant. The resulting model can be written as:

Hours Worked per Dollar Total Funds = 0.004 + 0.014*BR + 0.012*MSC – 0.00000001645* MSCTotalFunds - 0.003*SC + 0.002*Austin

It can be interpreted as follows: For non-BR, MSC nor SC projects not in Austin:

Hours Worked per Dollar Total Funds = 0.004 (i.e., 4 hrs per $1000)

For the single BR project (which was in Houston),

Hours Worked per Dollar Total Funds = 0.018 (i.e., 18 hrs per $1000)

For MSC (Miscellaneous Construction) projects,

Hours Worked per Dollar Total Funds = 0.016 – 0.00000001645* MSCTotalFunds
(i.e., about 16 hrs per $1000 with a small adjustment for project size)

For SC (Seal Coat) projects,

Hours Worked per Dollar Total Funds = 0.001 (i.e., 1 hour per $1000)

For Austin projects,

Hours Worked per Dollar Total Funds = 0.006 (i.e., 6 hrs per $1000)

The model statistics are given next (Table 3.12).

Table 3.12: Statistics—SPSS Result for Hours Worked

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.577	.333	.315	.002901139807737	.333	18.508	1	37	.000
2	.673	.453	.422	.002665296717768	.119	7.838	1	36	.008
3	.857	.734	.711	.001885543315005	.281	36.932	1	35	.000
4	.881	.776	.749	.001755770463896	.042	6.365	1	34	.016
5	.902	.813	.784	.001628207622049	.037	6.536	1	33	.015

The adjusted R-square at the final step is fairly good at 0.784, and the standard error is 0.0016. Thus, for a 95% confidence range on the estimate, the point estimate of Hours Worked per dollar Total Funds would be adjusted by +/- 0.003 or 3 per $1000. The next figure gives the fitted lines as estimated by the model.

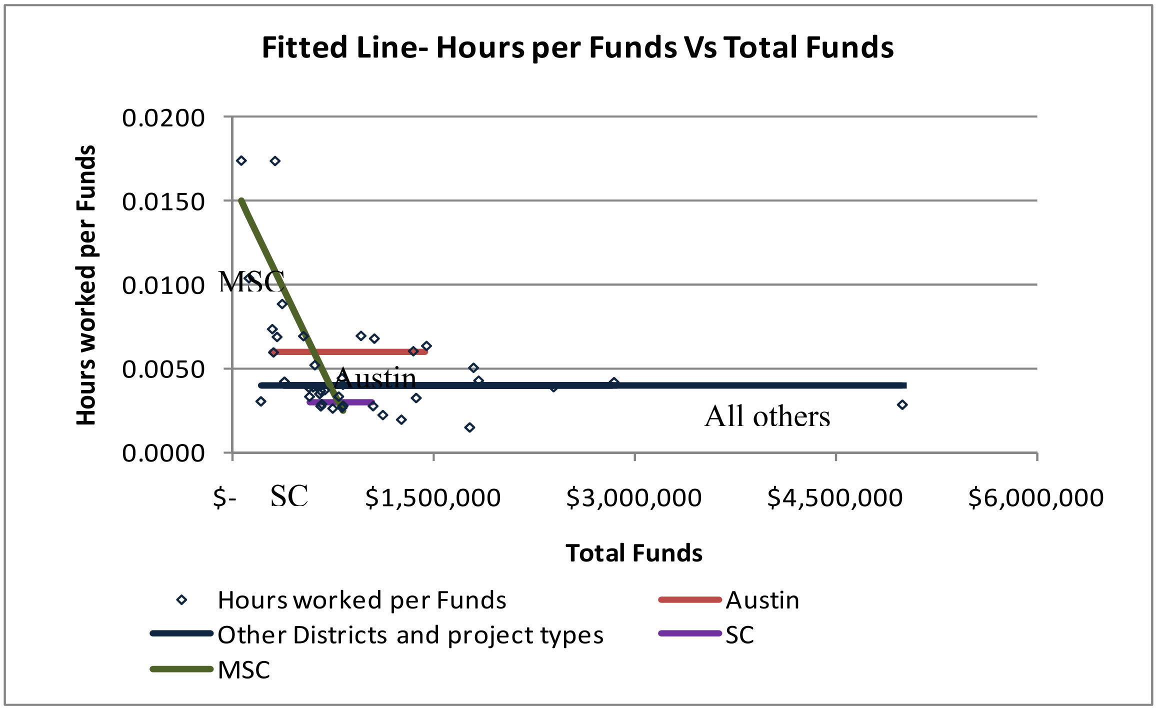


Figure 3.11: Fitted Line for Hours Worked per $Funds versus Total Funds

It is seen that the fitted lines appear to adequately estimate the Hours Worked per dollar Funds. However, the MSC line is misleading because it suggests that for a $1 million project, total hours would be zero. Thus, it must be accepted that the trends observed are specific to the data on projects completed to date.

3.2.6 Payroll per dollar Funds

Regression gave the following result for Payroll per dollar Funds (Table 3.13):

Table 3.13: SPSS Result for Payroll per dollar Funds

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
5	(Constant)	.059	.005		11.512	.000
	BRCONT	5.695E-7	.000	.508	6.786	.000
	MSC	.211	.021	1.155	9.916	.000
	MSCCONT	-2.886E-7	.000	-.900	-7.796	.000
	Austin	.041	.011	.308	3.707	.001
	SCCONT	-6.568E-8	.000	-.220	-2.705	.011

The variables are listed in the order of entry. No other variables make the threshold. The resulting model can be written as:

Payroll per $Funds = 0.059 + 0.00000057* BRFunds + 0.211*MSC - 0.000000289*MSCFunds - 0000000657*SCFunds + 0.041*Austin

It can be interpreted as follows: For non-BR, MSC nor SC projects not in Austin:

Payroll per $Funds = 0.059 (i.e., 5.9%)

For the single BR project (which was in Houston),

Payroll per $Funds = 0.059 + 0.00000057* BRFunds
(i.e., 5.9% + 0.57% per $ million Funds)

For MSC (Miscellaneous Construction) projects,

Payroll per $Funds = 0.059 + 0.211*MSC - 0.000000289*MSCFunds
(i.e., 27% - 0.29% per $ million Funds)

For SC (Seal Coat) projects,

Payroll per $Funds = 0.059 - 0000000657*SCFunds
(i.e., 5.9% - 0.07% per $ million Funds)

For Austin projects,

Payroll per $Funds = 0.059 + 0.041*Austin (i.e., 10.0%)

The model statistics are given next (Table 3.14).

Table 3.14: Statistics—SPSS Result for Payroll

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.463	.215	.194	0.050480	.215	10.118	1	37	.003
2	.628	.395	.361	0.044931	.180	10.704	1	36	.002
3	.855	.731	.708	0.030364	.337	43.828	1	35	.000
4	.881	.777	.750	0.028079	.045	6.927	1	34	.013
5	.904	.817	.790	0.025786	.041	7.316	1	33	.011

The adjusted R-square at the final step is 0.79, and the standard error is 0.0258. Thus, for a 95% confidence range on the estimate, the point estimate of Payroll per Funds would be adjusted by +/-0.0516 or 5.16%. The next figure gives the fitted lines as estimated by the model.

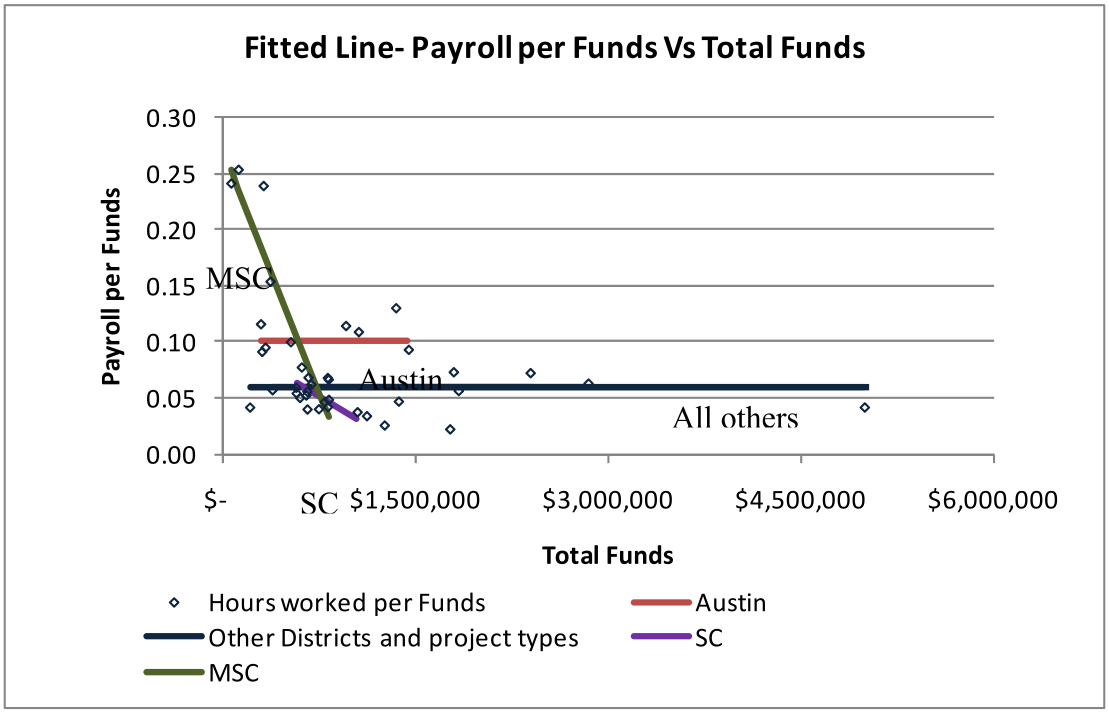


Figure 3.12: Fitted Line for Payroll versus Total Funds

It is seen that the fitted lines appear to adequately estimate the Payroll per $ Funds. However, again the MSC line is misleading because it suggests that for a $1 million project, payroll would be zero. Thus, it must be accepted that the trends observed are specific to the data on projects completed to date.

3.3 Conclusions

These results show that project labor and payroll can be adequately estimated from project construction cost and project type, but some TxDOT districts are significantly different from the rest. Specifically, the Austin area appears to have higher labor usage and payroll costs.

For this analysis, data was obtained from TxDOT on 39 construction projects completed between April and November 2009 with ARRA funds. Contractors on ARRA projects are required to submit labor hours paid (prime and subcontractor), and payroll dollars. Of the 39 projects, almost all are pavement preservation projects, with 29 being overlays. From this limited dataset, trends were observed suggesting that labor hours and payroll are related to project size (construction cost), project type, and location (TxDOT district).

It was found that, for the projects studied, labor hours and payroll per dollar project cost are fairly constant for most project types, sizes, and locations, with values of 0.004 hours per $, and 0.059 $ per $ (=5.9%) respectively. The Austin district had relevant figures of 0.006 hours per $, and 0.100 $ per $ (=10.0%).

Seal Coat and Miscellaneous Construction projects appear to have decreasing labor with increasing project size, but that may be a spurious trend due to the small number of such project types in the dataset (only two and four of these projects respectively).

It is recommended that this analysis be repeated at a later date when more projects have been completed, so that aberrations in the results can be ameliorated.

Chapter 4. Contractor Interviews

4.1 Introduction

Research Tasks 4 and 5 included interviewing contractors on ARRA projects to determine the indirect jobs generated by those projects. To do this, the researchers contacted the Associated General Contractors (AGC) of Texas, and that group assigned Mr. Thomas Bohuslav to assist. Mr. Bohuslav reviewed and approved a questionnaire to be used, and identified a selected group of contractors to be interviewed.

4.2 Contractor Questionnaire

The final questionnaire used in the interviews is included below.

4.2.1 Questions Regarding Indirect Jobs for Prime Contractor

1. Do you think the job report required by TxDOT provides an accurate picture of employees who worked directly on this project?
2. How many employees do you have that are not directly on job site (management, support, maintenance, etc)? What percent of the contract is overhead cost? (There can be project overhead management and home office overhead management. Management is home office and satellite office staff. Typically, these employees should be prorated per project or $1 M of payments received each year. There are also subcontractors and suppliers off the project, and engineering hired out).
3. How many or what percent of the direct on the project employees are local (within 60 miles)? (Employment can be dynamic. Reports are submitted each month.
4. Is this job typical of the types of projects your firm does? What percentage of your portfolio is this type of work? How has this changed over the past year? (The past year may be unusual regarding the type of work contractors do as volumes are down).
5. What percentages of your supplies are bought locally? (Specify if for the project in question or for all projects).
6. What percentage of the payroll for this contract reflects overtime/added pay (1/2 time factor)? Is this typical?
7. Can you estimate how much workers/the firm spent in the local area of the job site (lodging/food/support)? (This is for out of area cost such as temporary housing, etc., and for local employees, gas, food and other needs while on the project).
8. Can you provide the contact information for your major suppliers/sub-contractors for this project?
9. What percentage of the contract amount can you assign to your labor, equipment, material, transport, subcontractor, hauling, other?
10. Can you describe the phasing and timeline of this project?
11. Classify the type of work on this project. (Rehab, overlay, seal, bridge widen, etc. One or multiple.)

4.2.2 Questions Regarding Indirect Jobs for Suppliers/Sub-contractors

(Note that subcontractors and a few suppliers would not be considered indirect per ARRA.)

1. How many workers did you employ in support of this project and what were their roles? Is this typical of most of your contracts? (This may be difficult for suppliers to know which project their materials service).
2. What is the amount of labor needed to produce a unit of supply? How much labor is used in transportation to the job site, on a per unit basis? (Seek answers in man-hours, not people. Give some units, e.g., hot mix—2000 tons, bridge structure—cubic yard of concrete, bridge deck—square foot, earthwork—10,000 cubic yards.)
3. How many or what percent of the direct on the project employees are local (within 60 miles)?
4. What percentage of the contract amount can you assign to your labor, equipment, material, transport, subcontractor, hauling, other?
5. What is your estimate of the jobs within your business that were created or retained based on this project? Include home office overhead, or a prorated share.
6. Do you purchase supplies regionally by project, use the same suppliers regardless of project, or use a national network of suppliers? This would vary for each type of material.
7. Can you provide the contact information for your major suppliers/sub-contractors for this project?

4.3 Selection of Contractors

To select representative contractors for interviews, the researchers examined active projects and attempted to focus on those types of work that represent the majority of expenditures. Table 4.1 shows the percent of total TxDOT construction expenditure on the top 34 items, according to TxDOT's Highway Cost Index (HCI).

Table 4.1: Percent of total TxDOT construction expenditure on the top 34 items

#	Item	$ Percent		#	Item	$ Percent
1	Hot mix asphalt concrete	26.83		18	Concrete riprap	1.65
2	Flexible base	7.66		19	Plant mix asphalt concrete	1.55
3	Continuous reinforced concrete pavement	6.95		20	Asphalt stabilized base	1.55
4	Surface treatment aggregate	4.80		21	Lime treatment	1.49
5	Roadway embankment	4.61		22	Bridge rail	1.40
6	Surface treatment asphalt	4.55		23	Reinforced concrete pipe	1.35
7	Jointed non reinforced concrete pavement	4.11		24	Concrete box sewer	1.18
8	Retaining wall	4.00		25	Cement	0.67
9	Roadway excavation	3.43		26	Concrete piling	0.62
10	Regular beam	3.17		27	Jointed reinforced concrete pavement	0.54
11	Bridge slab	2.99		28	Cement treatment of subgrade	0.51
12	Class C concrete	2.74		29	Box beam	0.47
13	Concrete box culvert	2.51		30	Class S concrete	0.46
14	Reinforced concrete pipe (sewer)	2.16		31	Corrugated metal pipe	0.13
15	Drilled shaft	2.02		32	Class A concrete	0.09
16	Lime	1.90		33	Plant mix asphalt concrete	0.04
17	Metal for structure	1.86		34	Steel H piling	0.02

Upon investigation, it was found that several of these items could be grouped together into categories. Table 4.2 shows the nine consolidated work item groups.

Table 4.2: Top Items Consolidated in Nine Major Work Item Groups

Earthwork and drainage (17.33%)	Embankment/Excavation Reinforced Concrete Pipe Corrugated Metal Pipe Concrete Riprap	Subgrade Treatment (6.16%)	Cement Treatment in Place Cement Treatment Plant Mix Lime Treatment in place Lime Treatment Plant mix
Foundations (2.66%)	Drilled Shafts Concrete Piling Steel H Piling	Asphalt Mixes (45.39%)	Asphalt Base Treatment Plant Mix Flexible Base—Asphalt in Place Aggregate for Surface Treatments Asphalt for Surface Treatments Hot Mix Asphaltic Concrete
Structural concrete (11.37%)	Concrete Box Culvert/Sewer Retaining Walls Concrete (Class A, C & S) Bridge Slab Bridge Rail (Rigid)	Concrete Pavement (11.60%)	Continuous Reinforced Jointed Non-Reinforced Jointed Reinforced
Pre-stressed beams (3.64%)	Standard Bridge Beams Box Beams	Finishes (not in HCI)	Work Zone Barricades and Signs Pavement Markings Roadway Illumination Assemblies Permanent Signs
Structural metal (1.86%)	Structural Steel (Bridges, etc.) Metal Beam Guard Railing		

This analysis was shared with the AGC, and they recommended that the groups be further consolidated based on the typical kinds of work done by specific contractors. Table 4.3 shows the reduced list, along with potential on-site and off-site labor, materials, and equipment usage.

Table 4.3: Top Items Consolidated in Four Major Work Item Groups

Work group	Work items	On-site labor & equipment	Materials	Off-site labor
1. Base and pavement (59% of $)	Subgrade cement treatment Subgrade lime treatment Flexible base Asphalt base treatment Aggregate for surface treatments Asphalt for surface treatments Hot mix asphaltic concrete	Excavators and haulers Sheep foot rollers, graders Dump trucks Asphalt distributor trucks Asphalt spreading machines Vibrating rollers Smooth wheel rollers	Cement Lime Fly ash Seal coat aggregate Asphalt aggregate Liquid asphalt Asphalt admixtures	Make & transport Make & transport Make & transport Quarry & transport Quarry & transport Refine & transport Mix & transport
2. Concrete cast-in-place (22% of $)	Drilled shafts Concrete (Class A, C & S) Bridge slab Concrete riprap Conc. pavement—reinforced Conc. pavement—non-reinforced	Cranes, cherry pickers, etc. Concrete batch plant Concrete trucks, pumps Concrete buckets, chutes Vibrators, finishers Sprayers, misters, etc.	Formwork built-on-site Reinforcing steel Concrete aggregate Cement Concrete admixtures Curing compound	Lumber, scaffolding Cut, bend, assemble Quarry & transport Make & transport Make & transport Make & transport
3. Concrete pre-cast (17% of $)	Concrete piling Reinforced concrete pipe Concrete box culvert/sewer Retaining walls Standard bridge beams Box beams Bridge rail (rigid)	Cranes, cherry pickers, etc. Carpentry Masonry Setting and finishing beams	Formwork—multi-use Reinforcing strands Concrete aggregate Cement Concrete admixtures Curing compound	Cleaning and setup Jacking & tensioning Concrete batch plant Placement & curing Cranes Transport trucks
4. Structural metal (2% of $)	Steel H Piling Corrugated metal pipe Structural steel (Bridges, etc.) Metal beam guard railing	Cranes Welding Bolting Rail assembly	Structural steel Non-structural shapes Seating pads, bolts Wood or metal posts	Cutting and welding Welding x-ray Shaping, rolling Cutting, drilling

As a result of this grouping, the AGC identified four suppliers for interviews. Mr. Ken Barnett of TxDOT also selected three active projects (two pavement rehabilitation, and one arterial widening) for contractor interviews. These interviews were conducted in late 2009 to spring 2010. The researchers promised that the data given by the contractors would be "stripped" to remove identifications and proprietary information.

4.4 Interview 1—Company AAAA, Base and Asphalt Supplier

The interviewee is the President of AAAA and Owner. The interviewee joined the family business, an asphalt paving company, in 1993. They set up an asphalt production facility in 1996 and later acquired a limestone mining quarry. Limestone is mined from the quarry, crushed, and sent to the asphalt plant for asphalt production.

4.4.1 Operations

The quarrying process involves

a. Blasting
b. Crushing
c. Sorting
d. Stockpiling
e. Transportation

Figure 4.1 (reproduced from Owner of AAAA's material) shows the structure and supply chain arrangement of AAAA. The facilities owned by AAAA are shown in ovals. The arrows leading from one facility to another show flow of materials and goods. The adjoining notes relate to operation and maintenance of respective facility.

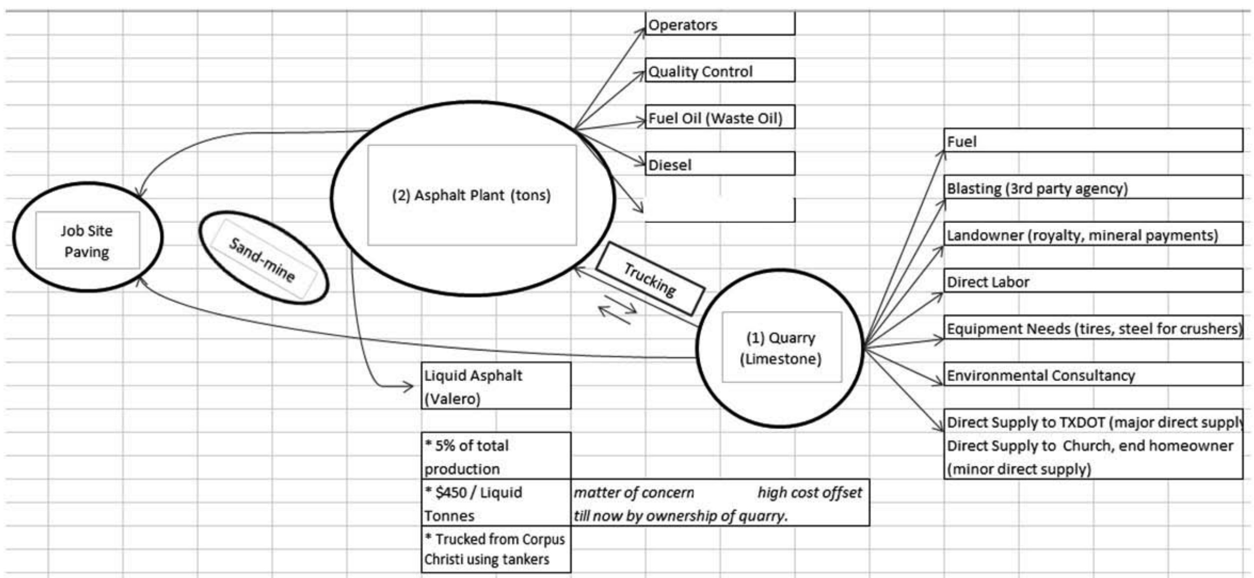


Figure 4.1: Structure and Supply Chain for AAAA Asphalt Suppliers

Front End Loaders are used in the quarry, some of which were funded by the Texas Commission on Environmental Quality (TCEQ) to have their motors upgraded to environmentally friendly ones. The quarrying itself takes place in an area of 175 acres and the adjoining 450 acres of land is declared environmentally protected. Periodic checks and testing is carried out to determine if the water quality of the aquifer underlying the quarry is being affected due to the operations. Water trucks are used for dust abatement during the quarry operation. According to AAAA's projections, the existing quarry can support their requirements and operations for the next 15 years. Sometimes, when TxDOT demands limestone of specific quality for certain projects, AAAA procures them from a nearby quarry (Quarry 2). This quarry is not owned by AAAA and is normally a competitor to AAAA's quarry, except in such cases where Quarry 2 is a supplier for AAAA.

Once AAAA's quarry becomes obsolete, the following options remain:

a. Convert it into a reservoir or a lake.

b. Restore the area by backfilling.

There are certain restrictions imposed by TCEQ on quarry and asphalt plant operations:

a. Quarry permitted to remain operational any 250 days in a year for 12 hours a day but quarrying at night is not permitted.

b. Asphalt plant is permitted to operate 365 days a year at the rate of 400 Tons/Hour.

Of the total operating costs of the asphalt plant (ballpark, approximate figures),

a. 25%–30% is transportation cost.

b. 10% is labor cost.

The transportation cost is lower because the quarry is quite close to the plant, leading to lower costs in manufacture and supply of final product. This coupled with the fact that SH 130 (new job site) is also quite close to the facilities helped AAAA in quoting lower prices and perhaps to eventually secure the contract. Following are some facts on operation of AAAA asphalt plant:

a. It is a volume-based facility.

b. They look to move around 500,000–700,000 tons per year of asphalt. If this quantity falls to less than 350,000, then it leads to positions getting eliminated.

c. Share of public and private projects being executed by AAAA Quarry is 90:10.

In March 2009, when construction works were severely affected by the recession, TxDOT bid tabulations began going downwards and bids were coming in below engineer's estimates. In 60 days after March 2009, profit margin for AAAA decreased from 7% to 2%. Some of the factors that contributed to this phenomenon might be:

a. Increased competition from unlikely firms (who usually wouldn't bid for such projects) in an effort to stay in business.

b. Higher crude oil costs.

c. Non-resident contractors bidding for projects in Texas.

4.4.2 Direct and Indirect Employment Generated by AAAA's business model

Total number of employees on payroll between corporate office and 3 other facilities is 28. The low number of employees is largely due to the fact that the asphalt and quarry operations are computerized and automated, leading to lesser labor requirement. A shift system is used in the operation of the asphalt plant and quarries.

At present, AAAA subcontracts all its transportation requirements to subcontractors, which includes transportation of:

a. Limestone from quarry to asphalt production plant.

b. Limestone from quarry to the job site.

c. Liquid asphalt from Valero (Corpus Christi) to asphalt production plant.

d. Asphalt from production plant to the job site.

e. Limestone from Quarry B (for specific TxDOT quality requirements) to asphalt production plant.

f. Sand from sand-mine to job sites.

g. Sand from sand-mine to asphalt plant.

The owner of AAAA, when asked if the company was evaluating prospects of buying their own trucks for transportation, replied that asphalt transportation trucks are tankers that are custom made for the purpose and purchasing them might not be feasible at present. However, they were considering benefits of buying trucks for general transportation (e.g., for items a, b, e, f, and g above). An 18-wheeler truck can carry 20 tons of asphalt per trip.

Subcontractors that do extensive business with AAAA are:

a. Trucking Companies (as described above)

b. Testing Company (Quality Control)

c. Blasting Agency

d. Drilling (for blasting) Agency

e. Environmental Consultants

The owner of AAAA elaborated on fallouts of slow business on the company operations. In essence, they would be the following:

a. Weekend work is stopped.

b. 12-hour shifts are reduced to 10-hour shifts.

c. If slowdown persists, 10-hour shifts are then reduced to 8-hour shifts.

d. Stand-by operator at the asphalt plant would be laid off. But because ARRA jobs came in, this position was not terminated.

e. Sub-contractors that worked for AAAA laid off 25 employees.

f. ARRA projects prevented further lay-offs.

g. If business picks up, more shifts are hired if overtime starts to exceed 25 hours.

Laying-off people is the last resort because re-forming staff for a technically specialized field like asphalt production is hard. However, if laying-off people is inevitable, the first ones to be let go at the asphalt plant are specifically the spotters and then other minimum wage types in general. Apparently, condition and number of people being laid-off has gotten worse in last 90 days (as of February 18, 2010).

All employees working at the quarry live nearby and support local businesses. It is possible to get more data on induced jobs in this area if TxDOT requires it.

4.4.3 Liquid Asphalt—Price Dilemma

The fact that Valero is selling liquid asphalt at an exorbitant rate of $450/liquid ton is a big risk and a matter of concern to AAAA. Pricing on a daily basis instead of futures/contract pricing compounds this risk. The fact that AAAA owns a limestone quarry and hence can control the price of that input has helped offset this risk. When asked, the owner of AAAA conjectured the following reasons behind such a high price of liquid asphalt:

a. Effort and expenses to adhere to increased regulations.

b. Cracking asphalt for making and selling gasoline and diesel is more lucrative.

c. Possible reason might be lowered demand coupled with costs of running the facility for a smaller clientele is leading to higher manufacturing cost per unit thus leading Valero to sell liquid asphalt to existing customers at a higher unit rate.

d. Sales tax and property taxes are big in asphalt business.

4.4.4 Interview 1 Summary

It was clear from the interview that between 3 facilities owned by AAAA, 28 people were directly employed. At least two of these were directly working at the asphalt plant as operators and rest were working at the quarry and sand-mine. Based on this input, it can be said that this asphalt company employs one person per 19,230–26,923 tons of asphalt produced per year. If production falls below 13,460 tons per year per person, however, the workforce begins to get cut back. The owner of AAAA also mentioned all their subcontractors could be interviewed to get more specific information on indirect and induced employment. All the quarry workers lived nearby and supported local businesses and hence it would be possible to gather information on induced employment if required. The researchers were invited to visit the facility on a field trip if the team wished to conduct more in-depth data gathering and analysis.

4.5 Interview 2—Company BBBB, Asphalt Supplier

BBBB is a large marketer of asphalt in North America. BBBB has an extensive line of paving asphalt coatings that include specialty polymer-modified asphalts, asphalt emulsions, asphalt sealants, and equipment, as well as storage of these products. The interviewee joined BBBB in 1994 as Vice President of Marketing and has been involved in the manufacturing of pavement application emulsions for more than 30 years.

4.5.1 Operations

Figure 4.2 (reproduced from the interviewee's material) shows the structure and supply chain arrangement of BBBB. The arrows leading from one facility to another show flow of materials and goods.

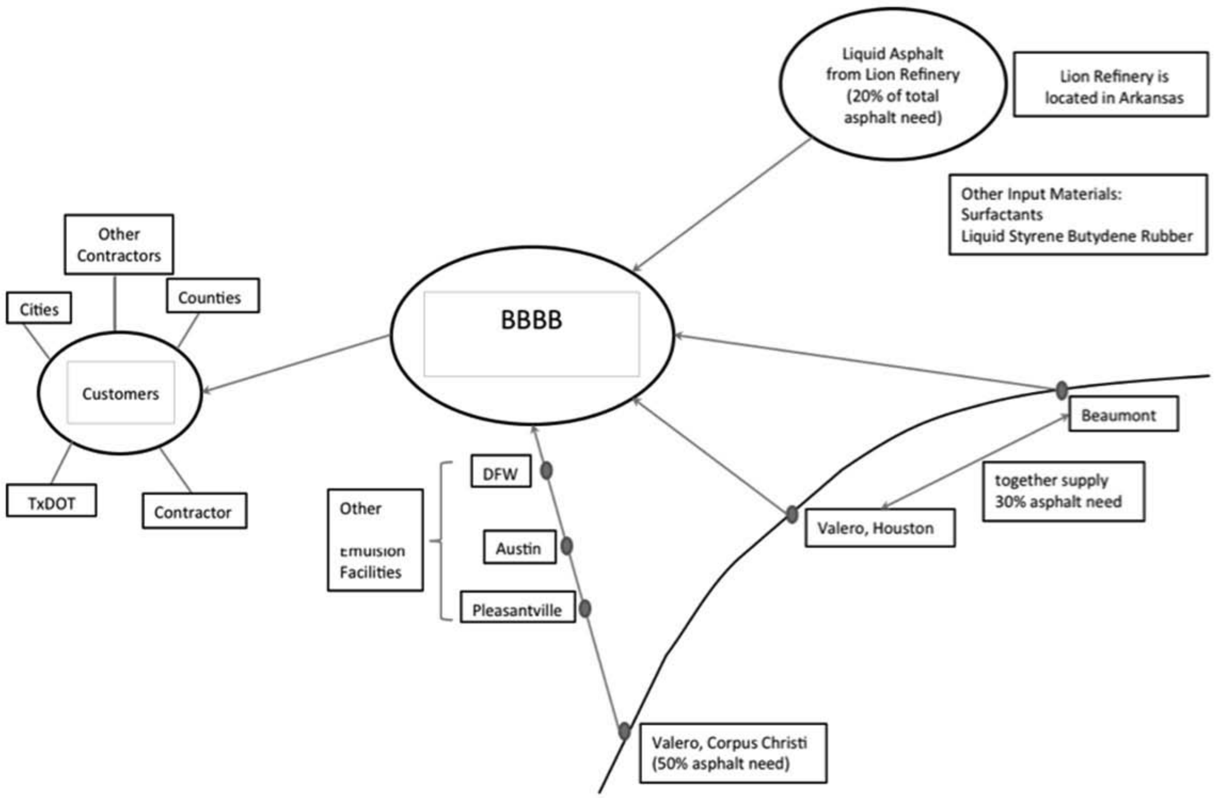


Figure 4.2: Structure and Supply Chain for BBBB Emulsion Suppliers

In general, the mix design for an emulsion is 65% asphalt + 1–2% chemicals + 2–3% polymer modifier + water. Transportation of raw materials and finished goods is a major cost for BBBB and although it owns a few trucks for the purpose, most of it is subcontracted to companies like STI, Groundhog, and Sun Coast. The liquid asphalt is transported at a temperature of 150–180 ^{o}F. BBBB intends to utilize equipments as efficiently as possible and tries to ensure that trucks are utilized on return trips as well. On a typical day, as many as 50 trucks carrying BBBB's materials are on the roads and truck movement at the facilities lasts up to 18–20 hours.

BBBB procures 50% of its liquid asphalt requirements from Valero (Corpus Christi), 30% from Valero (Houston) and a refinery in Beaumont combined, and the remaining 20% from Lion Refinery (Arkansas). BBBB has facilities to store asphalt in its plants where it can remain stable for a period of 6 months. A vital factor in business of asphalt or emulsion supply is the speed of response to customers. To this end, BBBB likes to be within 2 hours of point of supply.

General Notes on Asphalt Operations:

a. More asphalt can be obtained from sour crude oil than from light crude.

b. 4 gallons of emulsion is consumed in coating 1 sq. yd.

c. 6,000 gallons of emulsion is consumed for coating one lane mile.

d. Volume of asphalt is measured in gallons or tons at 60 ^{o}F.

e. An asphalt transportation truck gives a mileage of 17–18 mpg, which might go up to 30–35 mpg in future with more efficient engines.

4.5.2 Employment Specific Information

BBBB has several plants in Texas. Each facility has 1–2 marketing staff, one local manager, plant operator, material manufacturing technicians, truckers, and quality control personnel. Three operations manager are responsible for technical operations, product management, and human resources in all the plants.

The facilities are normally operated 6 days a week for 12 hours a day (6:00 a.m. to 6:00 p.m.) but this might go up to 24 hours a day in case of increase in demand. Each facility has seven full time employees. Two to three crews work every day at each of the plant with three to four people in each crew. On average, 6–10 people are working at each facility with 4–5 people working at any given time. In anticipation of and to cater to increased business as and when it arises, the company at present has more people on its payroll than is required. The interviewee said his company would consider hiring more people if the plant work-hours consistently exceeded 72 (=12 x 6) hours a week.

In addition to the aforementioned facilities, BBBB has a main office where 1,200 people work across all business units—Refining & Marketing, Asphalt & Emulsions, Transportation & Terminaling, Oil & Gas, Embedded Computing and Real Estate. Of these, one environmentalist, one safety personnel, few in procurement and two to three personnel handle customer load exclusively for Asphalt & Emulsions business unit. The Asphalt & Emulsion business unit's Management Office has four staff including the interviewee.

Maximum production is 200,000 tons/year with a 72-hour work week. However, due to decreased demand, if production falls down to 100,000–200,000 tons consistently (for a year or so), then 72-hour work weeks are reduced to 60-hour work weeks and some positions might need to be terminated. Contrary to this, if production needs to be raised to 200,000–250,000 tons, then one new crew (of 3–4 people) may be hired at each facility. The interviewee stated that even with current economic downturn and consequent decrease in production, no positions have been terminated yet but if the trend continues they might consider downsizing.

When asked about effects of ARRA projects on BBBB's business, the interviewee responded that it was his gut feeling that the stimulus projects have actually adversely affected their business. The reasons for this were:

a. Funds were diverted from BBBB's projects (major portion of which involves pavement preservation by emulsion coating) to fund new projects under the stimulus plan (major portion of which involves highway construction and asphalt overlay).

b. The federal funds were utilized to complete mobility projects. (Note: this was an incorrect assumption, as initially most ARRA funds went to quick-turnaround pavement projects.)

The interviewee, however, did admit that BBBB supplied materials for a few stimulus plan projects and this might have helped save a few jobs, but overall, ARRA projects were hurting BBBB's business. He also said that cost benefit ratio of pavement preservation vs. rehabilitation works is 6:1, i.e., every $1 spent on preventive measures would save $6 of construction. Hence, he suggested that instead of spending money on construction for rehabilitation, if the funds were used for preservation, the resulting savings can be used elsewhere in executing new projects.

The interviewee expressed his concern that the prevailing economic situation may lead BBBB to downsize its operations but stated that he was confident that the scenario might improve considerably over long-term.

4.5.3 Cost and Sales

The interviewee approximated the following to be associated costs in running the emulsion facility.

a. Material Cost: 70%–80%

b. Transportation Cost: 20% of cost of goods

c. Operating Cost: 15% of total budget

However, it is likely that the material cost might increase in the future due to reduction in supply because many refineries find it more profitable to turn asphalt in gasoline, diesel, and coke by the coking process. There is also an associated risk of variable pricing of asphalt because price of asphalt is determined by the output of gasoline obtained by cracking or coking. Cost trends (Texas Gulf Coast Asphalt Prices) for gasoline, asphalt, diesel, and coking process are tracked regularly by BBBB to study and try to predict the future trends.

Speaking of sales, the interviewee said that 90–95% of income of BBBB is generated from highway-related projects, 90% of which in turn are specifically public highways. This distribution remains the same even when economic conditions change, though the amounts involved do fluctuate with boom and bust cycles. Interestingly, the interviewee said the price of emulsions remains pretty flat and does not decrease if construction activities dip.

4.5.4 Interview 2 Summary

With 4 staff at the Management Office, 7–8 staff at Main Office, and 70 employees between the field facilities, the total number of jobs is 82. These field facilities also produce an average of 200,000 tons of emulsion per year. Consistent production of 250,000 tons per year gives employment to 3–4 additional people. Hence an increase of 17,073–20,348 tons of annual emulsion production translates to one additional job.

Because it was found in the first two interviews conducted so far that transportation is a huge component of cost (ranging from 20%–30%), the researchers deliberated and decided to consider studying the transportation sector in more detail.

4.6 Interview 3—Company CCCC, Precast Concrete Supplier

Company CCCC was formed over 60 years ago. Initially, septic tanks were manufactured in this facility but now pre-stressed beams are the sole products. CCCC supplied beams for first pre-stressed concrete bridge in Texas, in Victoria, in 1957. Before this, bridges were built using steel components, which the manufacturers took up to 2 years to supply. CCCC built that bridge for $25,000 less than a steel bridge and in less time. CCCC was also the first in U.S. to use neoprene pads and wooden forms for pre-stressed beams. CCCC currently produces thousands of pre-stressed beams each year, which are supplied all over US.

4.6.1 Operations

Figure 4.3 (reproduced from the interviewee's materials) shows the structure supply chain and cost breakdown network of CCCC.

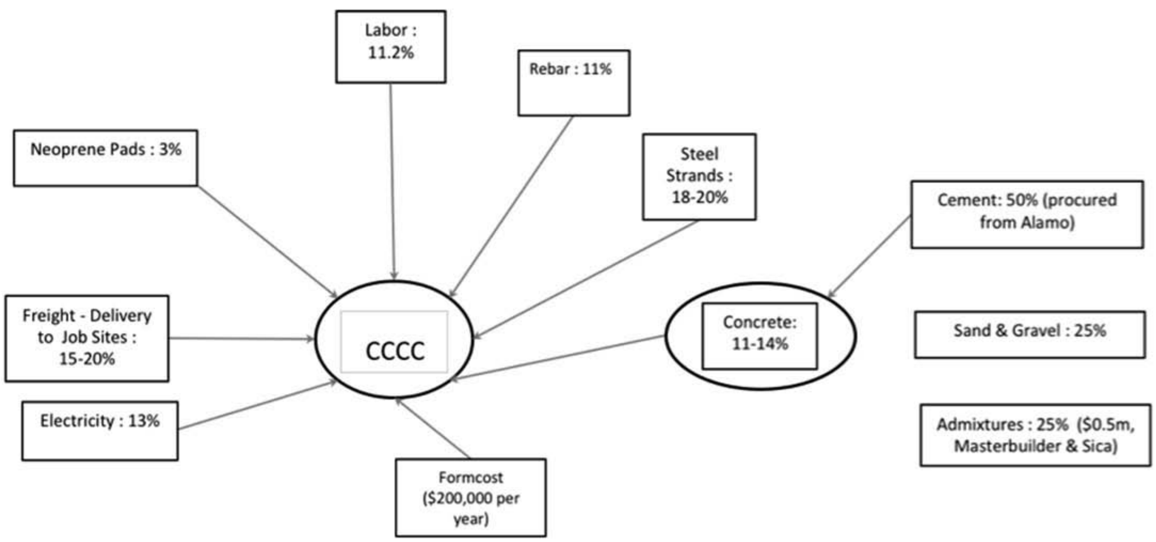


Figure 4.3: Structure and Supply Chain for CCCC Concrete Beam Suppliers

The beams are cast in long lengths of forms (up to 500 ft) and bulk headed to the desired end-shapes. The strands are stressed using hydraulic jacks after which the concrete is poured and allowed to set for a day. Thereafter, the reinforcement strands are cut and the beams moved to yard where they are inspected and stamped for approval by CCCC's quality control and TxDOT personnel. Finally, they are moved to the job site using custom trailers depending on the size of the beams.

Proximity to some of the largest sand and gravel deposits in the state makes CCCC's location ideal for such a facility. CCCC also has a similar facility near Waco with similar materials and products. CCCC obtains information on all the upcoming TxDOT jobs and then bids for supply of beams to the contractor who is executing the bridge construction. AASHTO A, B, C (1, 2, 3), 4, 6, 72" deep beams, and U-beams are some of the different types of beams being manufactured. All the products that CCCC manufactures are custom-made for a particular job in coordination with the general contractor. Some of the general contractors that CCCC works for are Austin Bridge Co., H.B. Zachry, Hunter Industries, etc. The work at the facilities is done in 24-hour cycles, i.e., concrete is moved 24 hours after pouring.

CCCC has competitors with plants in San Antonio, San Marcos, and Houston. An important factor in creating difference in bids amongst various competitors is the proximity of the plant to the job-site because freight is a major cost component in this industry. For transportation purposes, CCCC owns 12 trucks but a lot of subcontractor transporters are used, especially when delivery of certain beams requires customized trailers. Presently, CCCC is working on projects in Houston, Dallas, Red River, and few other areas.

CCCC buys sand and gravel from Fordyce, Victoria (which is largest independently owned sand and gravel supplier in the U.S.). Cement for the plant is procured from Alamo (which is largest independently owned cement company in the U.S.). Steel strands are of 0.5" or 0.6" size and are procured from a plant in Houston. The strand market is very volatile, with prices fluctuating monthly or even weekly depending on the price of scrap. This is a risk factor in CCCC's business because it bids a fixed price for a job. This means that CCCC will have to supply materials for the same price for a project over an 18-month duration even if the prices of steel strands go up. This scenario of price fluctuation was especially bad in 2008 when prices went up (the price of diesel was also volatile in this period) and CCCC had to bear millions of dollars in losses.

All the beams that CCCC produces are used in road projects. CCCC doesn't bid for commercial projects because there is no agreement on the standards used among various players whereas there are well-defined standards and inspection procedures in highway projects.

4.6.2 Employment Specific Information

CCCC employs 190 people in the home plant and 160 in Waco. The breakdown of specifics of employees at the home plant is as follows:

1. 20 staff on supervisory payroll—e.g., office, accounting (5 staff), engineering (3), purchasing and shipping (2).
2. 40 supervisors—hourly wage workers who are guaranteed pay for a 40-hour week even if the business is slow and they don't work as much; "blue/green hats."
3. 130 others—including 12 truckers, 3 mechanics, and 12 welders, with the rest working in concrete tying, pouring, and vibrating functions on hourly wages.

CCCC doesn't see much turnover in the first two categories and in fact most of these employees have been with CCCC for a very long time. However, the third category sees a very high turnover. Following are a few facts associated with this category of employment:

1. The work is hard, manual labor and normally these staff work 50–70 hours a week.
2. Usually unemployable people (low educational qualifications, little or no skills, etc.) can be quickly trained and used for these functions.

3. Usually, there is a 6–7 month lag from bidding stage to pouring of concrete for the beams to be supplied. Hence, hiring of additional people depends on the volume of work in pipeline from accepted bids.

CCCC also pays many benefits to its employees such as sick pay, vacation pay, holidays, profit sharing, health insurance, etc. CCCC is the only pre-stressed beam manufacturing company in Texas that pays these benefits to its employees.

The interview was of the opinion that his company had not worked on many ARRA projects. CCCC has a fixed overhead cost component because staff are almost never laid off. Presently, CCCC is considering adding 25 more people for its new concrete beam bed in Waco facility that serves North Texas. This additional requirement is to cater to the Dallas Area Rapid Transport (DART) project.

4.6.3 Markets and Costs

CCCC owns two cement trucks and two sand/gravel trucks that haul all their raw materials from the sources. The two facilities together produce about 600,000 feet of pre-stressed beams per year. CCCC supplies pre-stressed beams out-of-state as well; for example, railroad bridge beams are shipped to California, Washington, etc., and snow tunnels are supplied to Sierra. The interviewee said that DOTs are in the process of changing beam shapes, and this will necessitate procurement of new form materials. CCCC buys all its form from Hamilton Form. These steel forms usually have a long life but might be changed as per TxDOT's mandates. A 70' long new form may cost up to $400,000.

The breakdown in cost of operations of CCCC is as shown in Table 4.4:

Table 4.4: CCCC Expenditure for Concrete Beam Products

Item Description	Percentage of Total Cost	Remarks
Steel Strands	18–20%	
Concrete	11–14%	Of this, cement accounts for 50%, sand & gravel 25%, admixtures 25% (amounting to about $0.5m a year)
Rebar	11%	
Labor	11.2%	
Neoprene Pads	3%	
Form Cost	Up to $200,000 per year	
Freight	15–20%	"Freight" here means delivery of finished products to the job-sites and does not include transport of raw materials.
Electricity	13%	

Asked about transportation costs, the interviewee estimated it costs about $20/ft to hauls beams from the plant to a jobsite in Houston, of which $16/ft is trucker cost, $2/ft is for escorts, and $2/ft is for permits.

4.6.4 Indirect Employment

The interviewee mentioned that the sand and gravel company usually employed up to 100 people but given the recent slowdown in business only 75 were working right now. These sand and gravel companies supply bulk materials to commercial and institutional contractors in addition to CCCC. Hamilton Form, the firm from which CCCC buys all its form materials, employs around 100 people. The interviewee mentioned that the form and reinforcement bar industries employ highly skilled workforce who are laid off when economic activity takes a downturn. Hence, these are some of the industries that are responsive to ARRA funds.

Other industries that CCCC buys its materials from are neoprene and rebar manufacturers. Neoprene manufacturers supply neoprene pads that are used at the junction of pre-stressed beam and concrete columns. CCCC buys its rebar from a factory in Seguin. The price of the rebar depends on the price of scrap because scrap is melted in a furnace and recast as rebar, which is cheaper than buying fresh steel. General and highway contractors use ten times as much rebar as CCCC. CCCC spends almost $500,000 each year on buying various permits, the cost of which is billed into the bids.

4.6.5 Interview 3 Summary

Given the fact that CCCC had not worked on many ARRA projects and the fact that their employment generation depends on the number of projects in the pipeline, it is clear that ARRA funds have not had much impact on this particular industry. This might be because the firm's area of function is limited, i.e., supplying only pre-stressed beam only to highway projects, or that ARRA funds up to that time had not been allocated for bridge projects where beams are primarily used.

Also, as per the interviewee's opinion, stimulus funds had more impact on industries that employ highly skilled workforce such as rebar and form manufacturing companies. He also gave his opinion on globalization leading to foreign ownership of raw material sources (steel and iron, cement industries, etc.) thus allowing price fixing and monopolies even though these are illegal in the U.S. He also suggested that incentives like tax cuts or a decrease in employers' percentage contribution to Social Security Fund would not encourage employers to hire more people; instead, long-term solutions must be implemented that can guarantee sufficient direct work for the company.

4.7 Interview 4—Company DDDD, General Contractor

The interviewee came with a handout answering several questions off the interview form. Those answers and additional notes are documented here.

4.7.1 Role in the construction business

- DDDD are prime contractors involved in civil construction—excavation, underground utility (water, sewer, storm water, gas and electrical), concrete (flat work, paving, bridges, walls, drainage structures), paving, etc. All their hot mix, asphalt work etc. is done by two to three subcontractors.

- o Commercial site projects—IBM, 3M, malls, shopping centers, office complexes
- o Residential/commercial subdivisions—Developers, home builders, corporate and industrial parks. Activity in these sectors is slow right now.
- o Public Infrastructure—TxDOT, cities, counties, airports, military bases, Corps of Engineers.

4.7.2 Outside Suppliers and Subcontractors (Over 800 companies in 2009)

- Materials supplied by suppliers and subcontractors: forming materials, steel, rebar, ready mix, crushed aggregate, hot mix, lime, all types of pipe, precast—boxed, inlets, beams, walls, etc. Figure 4.4 illustrates DDDD's supply chain.

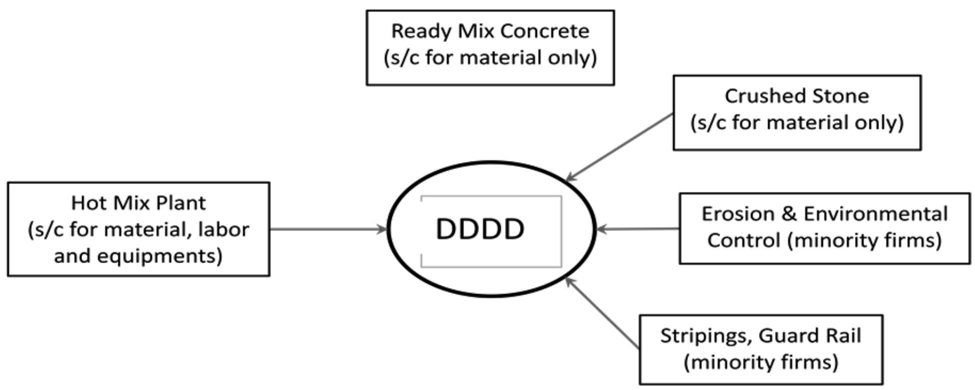


Figure 4.4: Supply Chain for DDDD General Contractor

- Services provided by suppliers and subcontractors: equipment repair, banking, insurance agents and companies, bonding agents and companies, information technology, trainers, safety consultants, leasing companies, equipment sales/rental, engineers, material testing, tax consultants, attorneys, printers, auditors, security, trade associations, medical clinics etc.

4.7.3 Facilities, infrastructure and equipment owned

- Office facilities: 10,000 s.f. home office
- Shop/service facility: 10 acres
- Heavy highway equipment: over 400 units owned currently (which is down 30% since mid-2008)
- No plants or crushers

- DDDD's equipment is stored at the yard but all the materials are transported directly to the job site. DDDD owns a few trucks but most of the transportation requirements are subcontracted to minority firms.

4.7.4 Employment structure—Austin/San Antonio

- Number of employees: 2008 in 350; Current—200
- Salaried: 50; Hourly wage workers—150
    - Of the salaried personnel, 15 work at the office and around 25–35 are foremen and general supervisors.
    - The organization structure of DDDD is as follows:
        - Vice president (VP), Construction Operation
        - VP, Finance
        - VP, Administration & Estimation (also responsible as Project Construction Manager)
        - Division Manager (responsible for underground, concrete, utilities, etc.)
        - Superintendent
        - Foremen
        - Lead men (crew heads)
        - Hourly workmen
- DDDD has a good training program for employees.
- Output measures to determine staffing needs: in the past, DDDD planned for future labor requirements and attempted to have a well trained and qualified labor force ready for planned growth needs. But in this current market, lack of confidence in construction spending causes the management to spend all of its time trying to utilize the existing workforce.
    - "In house rules of thumb" are used to determine the required crews/man-hours necessary to meet current work, e.g., M/H required per cubic yard of excavation or concrete, per ton of flexible base.
    - There are around 30–40 activities for which such 'rules of thumb' exist.

4.7.5 Impact of ARRA Funds

In DDDD company, no new jobs were created by these additional funds but they had a very positive influence on retaining the current workforce and preventing additional layoffs.

- The company had a steady growth for many consecutive years until 2009. The company had large number of projects on its books just 3–4 years before 2009. In fact, there was such a shortage of workers during this period that existing employees had to work overtime; the normal workweek was a 55-hour week at an average of 10 hours per day.

- Even though TxDOT projects have less profit, the associated risks are fewer and hence DDDD prefers working on TxDOT projects more than others. Also, TxDOT specifications are very clear and hence the contractor knows the exact works to be done. However, amount of funds (in dollars) spent by TxDOT has declined over the past 2 years and there is increased competition from firms who would not, in normal circumstances, bid for such projects.
- Usually 35–40% of DDDD's business is TxDOT-related projects but given the downturn in private projects following the recession, TxDOT projects now comprise 70–75% in Austin and 85% in counties.
- A small backlog of jobs is one of the reasons that business is not lower than it could have been otherwise.
- Following the recession, when DDDD had to let some people go due to lack of projects, the average workweek dropped to a 40-hour week but it was observed that the productivity has increased tremendously at the same time. The work that usually took 10 hours was being done in 8 hours.
- Since the value of orders has decreased, cost of General Administration (GNA) has gone up from 6–7% of total cost to 8–9%. DDDD uses GNA to monitor the status of the order books. The lower the GNA, higher the dollar amount of works in execution and/or in pipeline.
- Of the total cost of operations, labor accounts for 60–65% and equipment costs account for the rest.
- Specific information about DDDD's hiring plans:
    - DDDD will consider hiring additional staff as and when the order backlog increases to a level that they seem comfortable with. DDDD uses Primavera (a project scheduling software) to calculate the quantity of anticipated work and the aforementioned 'rules of thumb' are then used to foresee manpower requirements.
    - DDDD bids for projects that are in and around the Austin and San Antonio area. DDDD does not like taking up work in far-flung areas, hiring people temporarily to complete such jobs and laying them off once the job is completed. They are also not very willing to readily lay off employees. Hence the location of projects must be convenient to people already on the DDDD payroll.
    - DDDD feels that the volume of work is picking up now and feels comfortable with it. The workweek has now gone up to 45 hr/week from 40 hr/week.
- The interviewee was of the opinion that subcontractors had laid off employees following the recession but would be quick to start hiring as soon as the volume of work picked up.
- DDDD was currently working on four ARRA projects that accounted for 9–10% of their order book in dollar amount. Two of these are in the process of being wrapped up.

- When queried about his opinion on number of induced jobs generated/supported as a result of employees working on ARRA projects, the interviewee replied that they were spending their income only on basic necessities such as food, rent, and utilities and almost nothing was spent on items like cars, boats, etc.
- The interviewee also suggested that incentives like tax credits would not be of much help in encouraging employers to start hiring if they did not have enough work on their order books.
- In reply to a question on his suggestions for better utilizing stimulus money/better measures to revive growth of economy, the interviewee's response were:
    - $27 billion that was allocated for highway projects among 50 states was not enough and at least $50 billion would be required to bring market confidence up to mark and thus increase order backlog. These funds should also be better directed and allocated such that they can be utilized immediately.
    - Legislations should be passed based on evaluation of long-term impacts. Stimulus package was more of a short-term patchwork solution and such measures do not inspire investor or contractor confidence. Hence such stimulus packages do not achieve the objective of generating jobs. Even though DDDD wishes to grow and start hiring once again, this lack of confidence is preventing them from doing so in the immediate foreseeable future.
    - TxDOT funds should be leveraged to finance county projects.

4.7.6 Interview 4 Summary

As in the previous interviews, this interviewee was of the opinion that while ARRA projects had not created many new jobs, they had helped support the existing staff. He also said that contractors would consider hiring additional staff when they have sufficient confidence and a certainty of future work or a healthy backlog of work orders. This cannot be achieved by giving incentives in the form of tax breaks. Also, the sectors that were impacted more seriously by the recession (such as some of the subcontractors working for DDDD) and were quick to lay-off people would also be the first to start rehiring when the economy improves. The interviewee also suggested some measures that might help revive contractor confidence leading to job creation, such as long term transportation funding and more leveraging of local funds.

4.8 Interview 5—Company EEEE, Transportation Contractor

EEEE was established over 15 years ago with a starting fleet of 10 units in bulk lime service. Today EEEE has expanded its fleet to 44 lime-transport trucks, 39 asphalt-transport trucks, and 80 freightliner tractors. EEEE owns two fleets of trucks involved in the business of exclusive transport of bulk lime and liquid asphalt. Most (98%) of EEEE's operations are in Texas and the rest are in Oklahoma, Louisiana, Arkansas, and New Mexico.

Lime is mainly used in east Texas as stabilizer in the preliminary stages of highway construction due to presence of softer earth. Alternatively, cement and asphalt can also be used. Lime is also used in steel mills, paper mills, water treatment plants, and other construction jobs.

4.8.1 Lime Transportation

For the last 12 months, the share of lime transport in EEEE's total business has fallen to 10% from 50%. Consequently, EEEE, which owned 65 lime-transport trucks, had to sell 21 of those by auction. EEEE owns a few terminals in towns in the vicinity of lime-producing facilities such as Cleveland (TX), Austin, New Braunfels, etc. Supply of lime to steel mills is in decline due to the recession. Also, the supply of lime for road construction works has seen a dramatic decrease and continues to wane.

The interviewee stated that he was not aware which of the projects that he supplied transportation services for were being ARRA funded but he had heard that most of the funds were being used for minor repairs/rehabilitation work.

4.8.2 Asphalt Transportation

Lime is a non-hazmat substance to transport and hence no special training is necessary for the drivers. However, asphalt is classified as a hazmat substance and special training and stringent security measures (including background check) are required before licensing the driver. EEEE provides a 30-day training program for hazmat drivers and it takes up to 3 years to get a license for driving a hazmat truck.

EEEE owns 49 asphalt-transport trucks. Following the recession, the asphalt transportation unit has seen a 15–20% decline in business. Business in asphalt transportation for roofing and roads has been flat for some time. EEEE does a major part of its business with lime and asphalt producers and minor business with contractors and other agencies. EEEE has two lime producers as clients and it hauls 100% of goods for one of these. EEEE also caters to the major transportation requirements of four to six asphalt producing customers. Company BBBB is EEEE's largest customer. The nature of business is not contractual per se but EEEE sometimes needs to bid for work orders. Because major work is done for lime and asphalt producers, the returning trucks are empty (especially asphalt trucks) and hence EEEE's operation model is more of a one-way haul rather than relay haul (e.g.: Point A – Point B – Point C – Point A).

EEEE hires one driver for each truck working for 14 hours a day of which driving cannot exceed more than 12 hours. A master list of driver's hours is maintained at the terminal locations and when a driver runs out of hours, someone else is deployed if demand is high enough. EEEE is expecting more work in next 30–60 days due to confidence in general economic activity picking up coupled with better weather. Also, there is a historic trend of business picking up in spring and summer. The interviewee noted that this confidence did not stem from the fact that ARRA projects are being built. Given the optimistic outlook, EEEE is planning to hire 13 new drivers.

4.8.3 Employment-Specific Information

The total number of employees working for EEEE is:

1. 80 drivers
2. 13 administrative staff
3. 6 mechanics

4. 2 tiremen

The employees include both lime and asphalt transporting units/fleets. EEEE tries to hire truckers from places as close to the plant location and point of delivery as possible to minimize cost of driving to and from their home. When asked if he felt there was any impact of stimulus funds on creation of jobs, the interviewee responded that he could not say anything regarding that. For a follow-up question on whether he felt the stimulus funds had saved any jobs, he replied that to the best of his knowledge he was not aware that those funds had any substantial impacts on saving jobs in his line of work. He also did not observe any spike in business when a number of resurfacing jobs was contracted in summer/fall of 2009.

Regarding payment for drivers, it can be done in three ways: pay by hour, pay by miles, or pay by gross. Every transportation company pays its drivers through one of these modes. EEEE pays its drivers by gross. Following the economic slowdown, EEEE had to sell off 20 trucks and lay off 20 drivers; 10 drivers left their jobs. The drivers left the jobs because they were not earning enough as they are paid a percentage of revenue, and fewer miles mean less earnings. There has been no rehiring since. In addition, overtime of mechanics was cut back and administrative staff had their workweek cut down to 40 hours.

4.8.4 Other Business and Market Practices

EEEE uses its trucks for about 6–8 years though bigger companies use them for 2–3 years. The trucks are bought from dealers (relationship based). Older trucks are either sold to the dealers or auctioned. Because maintenance cost increases as the truck gets older, oldest ones are usually sold first. Fuel surcharge is levied to cover price fluctuations in fuel prices.

Typical truck capacities:

- For one trip in one day hauling lime—50,000 pounds
- Typical hauling capacity for asphalt—6,500 gallons (approx. 50,000 pounds)

EEEE has the following competitors:

- 3 companies that transport only asphalt.
- 2 companies that transport lime and asphalt.
- 1 company that transports cement, lime, and asphalt.

About 35–45% of EEEE's business is related to TxDOT projects. The interviewee was asked about various major cost components in his business and they are as follows:

- Cost of Truck: $115,000–$120,000
- Cost of Trailer: $80,000
- Maintenance: $0.12–$0.15 per mile (maintenance starts after the truck clocks first 50,000–80,000 miles)
- Mileage: 6.4 mpg

- New fuel-efficient engines may cost up to \$15,000–\$18,000 more than conventional engines.

Even with the recession, there has not been much change in freight prices because much of the cost components remain constant and the only area where cost can be reduced is labor. EEEE had also added three new product lines for transportation—namely, cement, fly ash, and barite—but they had to discontinue since the deal with the prospective customer fell through. They did purchase some trailers for the purpose.

With the slowdown in economic activity in the U.S., a trucking company from outside tried to establish business in Texas but could not carry on with operations due to excessive low-bidding and abandoned its operations in Texas about a month back.

The interviewee was asked to make his suggestions for stimulating transportation business in order to generate jobs. He replied that because he mainly worked for lime and asphalt producers, the only way to achieve the objective of increasing number of jobs would be if his customers in lime and asphalt industry gave him more work. This would happen if these customers themselves had more work such as increased highway construction for which they could supply their materials.

4.8.5 Calculation of Transport Labor Productivity

The idea here is to estimate the number of trucks and thus the number of drivers whose work is supported per unit consumption of materials on a job site (concrete, asphalt, lime, etc.).

Say you are a transport contractor who receives an order to supply X units in 1 day to a jobsite. You want to estimate how many trucks you need for the job. Your calculation would be based on how many truckloads per hour are needed, and the roundtrip time for one truckload.

No. of Trucks = [Time for Round Trip (hrs) x Frequency of Arrival (trucks per hour)]
= [2 x (Drive Time + Loading Time + Unloading Time) (hrs) x (Material)]

Usage at Site (tons per hr)/Truck Capacity (tons)

⇨ No. of Trucks = Trip Time (hrs) x (Usage rate (tons per hour)/ Truck Capacity(tons))

We can reformulate this equation as:

⇨ **Usage Rate (tons/hr) = (No. of Trucks x Truck Capacity (tons)) / (Trip Time (hrs)**

Units: Usage Rate – tons/yr
Truck Capacity – tons/hr
Trip Time – hr

The Usage Rate in tons per hour thus calculated can then be mathematically manipulated to obtain consumption per year at that site. Restating the equation:

⇨ **No. of Trucks = Usage Rate (tons/yr) x (Trip Time (yrs) / Truck Capacity (tons)**

⇨ **No. of Jobs = [Annual Material Usage Rate (tons/yr) /Truck Capacity (tons)] x (Roundtrip Time per load (expressed as a fraction of a year)**

This formula estimates the number of jobs supported in trucking due to transportation of materials. The two key variables are (1) the total consumption of the material per year, and (2) the roundtrip time per load expressed as a fraction of a year. The latter may better be understood as the inverse of the number of loads per year.

4.8.6 Interview 5 Summary

The interviewee said that the recession had drastically reduced his volume of business, leading to reduction in equipments and personnel. He also felt that ARRA stimulus funds had helped him neither create nor save any jobs at his company. Though the situation seemed bad at the present, he was hopeful of growing business in the next 1–2 months given historic trend and general improvement in economic activity and hence was looking to hire additional drivers. He also suggested improving consumption of lime and asphalt by taking up more highway projects as a measure to create jobs in transportation sector.

4.9 Interview Conclusions

Different work sectors within the construction industry have different trends for job creation/job loss. Employment in material transportation appears to be based on the owner's prediction of future workload. This means that growth or loss of jobs is dependent on confidence in the economy. (It might be easier to study the economic impact of ARRA or any other business scenario on transportation industry if this predictive nature can be modeled.) It also appears that the compensation structure in a particular sector may play a role in job creation/loss. Truck drivers are paid either by mile, by gross, or by hour. Demand for fewer miles means less/zero pay, which is equivalent to being out of work (job loss), while demand for more miles means job creation, because each driver has a limit on driving hours. Owners shrink their labor force by cutting hours until drivers leave, then sell off the older trucks. They grow their force by buying new trucks and hiring new drivers. This insight also suggests that job growth in the trucking sector is directly correlated with induced labor in the truck manufacturing sector.

Interviewees generally confirmed the accuracy of the ARRA jobs reporting, but the researchers quickly learned the importance of work hours and overtime in road construction. Most companies interviewed were in a state of distress with commercial business down, and TxDOT work not able to make up the difference.

When their workforce is underemployed, companies generally choose to "absorb" new ARRA contract hours using existing skilled and semiskilled workers. Therefore, new hours generated as a result of ARRA-funded projects typically have not created new jobs. All contractors reported increased competition for public-sector project bids. Traditional employment modeling techniques may be inadequate primarily because they do not address the way that contractors behave in economic downturns.

Chapter 5. Project Case Studies

5.1 Introduction

A widely used approach in determining employment impacts is through the use of models that rely upon input-output analysis. Such I-O models typically utilize information from input-output tables constructed and maintained by the Bureau of Economic Analysis, wage and employment surveys administered by the Bureau of Labor Statistics, Census Bureau demographics, and spending data. However, the estimation techniques of these models are not typically transparent, rely too heavily upon generally accepted growth trends that may not be accurate, and can yield vague results. Interviews with two practitioners of these I-O models [IMPLAN and REMI (Regional Economic Models, Inc.)] confirmed the opacity of these models.

As observed repeatedly in the contractor interviews, firms tend to adjust the work-week hours of existing employees before hiring new workers, and the researchers could not determine how models account for this phenomenon. Moreover, the models potentially may use data that do not necessarily reflect the current economic situation. For example, the Bureau of Economic Analysis' Input-Output Data have not been updated since the recent economic downturn.

An alternative approach was to evaluate the indirect employment impact of ARRA highway investments by gathering data from suppliers and subcontractors associated with specific projects rather than relying upon the more aggregated county-level and state-level data. This methodology was piloted with two case studies selected by Mr. Ken Barnett of TxDOT. These two projects represent the two major categories of TxDOT highway construction: pavement preservation and mobility improvements.

5.2 Case Study—Pavement Preservation Project

This job was chosen as a "typical" pavement preservation project involving resurfacing a stretch of road. Pavement projects were typically the first ARRA projects to be funded because of the quick time to prepare construction plans and initiate a contract, with the expectation that the material-intensive nature of the work would generate downstream employment.

5.2.1 Project Information

Contractor: Name Omitted for Anonymity, San Marcos, TX
Award Amount: $955,283.03
Work Begun: 7/20/09
Scope of Work: Resurface 0.58 miles of US 77 in La Grange, TX
Direct Employees: 165
Direct Hours: 6593
Direct Payroll: $108,617

5.2.2 Direct Jobs

The contractor emphasized that the procedures for counting direct jobs on site as part of meeting the requirements for the ARRA funding were very rigorous; consequently the 165 direct employees reported for this job is an accurate representation of the employees working on the site. In addition, the contractor stated that it had the same crew work the entire duration of this job, thus minimizing the chance of "double counting" a single job function. Further, the contractor elaborated on the allotment of overtime hours; this job reflected a typical overtime scenario of 10% of the payroll. Overtime is not a method to reduce employees needed for the job, but rather a reflection of the time of year and conditions of the work. In all, this particular preservation job seemed to reflect an accurate count of direct employees on site with little room for distortion.

Regarding off-site (overhead) employment, the contractor said that allocation of overhead employment on a per project basis is not possible for their company; they rely on a "core" group of overhead staff that adapts to different jobs and do not only work on a single job. The contractor would not provide an estimated percentage of overhead as part of overall project costs, and thus overhead employment could not be derived on a payroll basis. However, the contractor did state that its overhead is kept at a minimum to provide a competitive advantage, and that the recent recession has not impacted this staff. Overhead jobs were likely not impacted by this single preservation job based on this information from the contractor.

Finally, the contractor noted that no employees were hired locally for the job; thus, the direct job impacts can be attributed to the company's home area, in and around San Marcos, Texas.

5.2.3 Supply Chain

In this case, the main contractor also owned the major supplier of aggregate and hot mix. The contractor stated that a job of this size ($955,283) would have very little overall impact on suppliers, and would not produce a notable job impact. The only other major supplier identified was the asphalt supplier, a very large refining company that would also likely not be able to disaggregate this specific job from its overall production. This finding highlighted that the idea of disaggregating job impacts on a project by project basis is unrealistic.

The contractor also stated that, for this job, no supplies were purchased in the locality of the job; thus any potential indirect or induced impacts would not accrue to the area around the project site.

5.2.4 Extrapolation

The contractor confirmed that this job was a typical pavement project. This particular category of work as a whole had increased as a portion of their overall work since ARRA funding. The contractor also stated that the aggregate impact of all 15 ARRA jobs won by their company had likely allowed them to "save a crew" of employees (keep his four crews, instead of laying off 1). In addition, the company had maintained a steady level of employment through 2009. Thus, the single ARRA project does not necessarily lend itself to extrapolation, because the individual impacts are difficult to disaggregate.

5.2.5 Potential Induced Impacts

Neither direct employees nor supplies were obtained locally to the project; thus, any induced impacts from spending by the direct or indirect employees of the project would have been in and around the contractor's home base and the various small suppliers for the project. This project was very small relative to the overall revenue stream of the companies, and the type of work involved very few suppliers and contractors. The main contractor in this case also owned a major supplier for the project, and thought that indirect job impacts would be negligible for this particular project.

5.2.6 Case Study Conclusions

The interview for this case study led to several important conclusions. First, the single project approach was not appropriate in assessing job impacts. Even though direct jobs are counted for each project, individual projects are part of a large aggregate of jobs by which contractors make their personnel and financial decisions. Therefore, in order to make any statements about job impacts, the ARRA funds must be considered on an aggregate level. In this case, the contractor believed that jobs were saved by the aggregate of ARRA projects—this jobs-saved number is much more valuable than any direct job count number of employees on-site.

Secondly, as the overall money awarded to the project spreads through the supply chain, the impact becomes smaller and broader. Thus, suppliers would be highly unlikely to have any disaggregated information about employment related to specific projects. In the case of suppliers, the entire ARRA impact may even be difficult to disaggregate.

Finally, this contractor highlighted the importance of each company's business model on the ultimate employment impacts of any stimulus or downturn. By having an integrated model with a core group of people, this contractor was able to maintain employment throughout the downturn. In other words, the business structure or model of the companies in an industry is the most important factor in employment creation. The same amount of stimulus funds would have different employment impacts on different companies. This finding further supports the earlier indications that I-O models may not be the best tools for estimating employment impacts in the construction industry.

5.3 Case Study Addendum: A Supplier's Perspective

5.3.1 Introduction

The preservation project case study only provided insights regarding the impacts of the ARRA funding from a prime contractor's perspective. Because that prime contractor was also the major supplier for the project, a supplier's point of view was lacking. Therefore, the major supplier for another preservation project was interviewed.

5.3.2 Project Information

Contractor: Name Omitted for Anonymity, Buda, TX
Main Supplier: Name Omitted for Anonymity, Austin, TX
Contract Amount: $1,054,970
Work Begun: 7/06/09
Scope of Work: Resurface 2 miles of State Highway Loop 1 in Austin, TX
Direct Employees: 104
Direct Hours: 7,110
Direct Payroll: $113,637

Similar to the initial project studied, this preservation job was quick in mobilization and brief in duration.

5.3.3 Supplier Interview

In this case, the supplier provided asphalt to the prime contractor; the costs associated with the asphalt were a substantial amount of the job's total budget. The supplier did not hire any additional employees for this project. This is partly explained by the high level of automation associated with the supplier's business model. However, the supplier said that this project, coupled with another contracted ARRA job, helped to delay employee layoffs for several months.

5.3.4 Sub-Suppliers

The main supplier interviewed also owned its own quarry and thus provided the main component of the asphalt—crushed rock. The liquid asphalt used by the main supplier was provided by a large national refinery. Because this particular project would be an extremely minimal portion of the refinery sales, contacting them in an attempt to ascertain the indirect job count for this particular project was not feasible.

5.3.5 Potential Induced Impacts

Because the employees of suppliers tend to live close (within 60 miles) of the plant/factory, induced impacts would be in the general area of the supplier plants.

5.3.6 Case Study Conclusions

The interviewees reiterated that the individual project approach was not appropriate in assessing job impacts. In this case, the supplier believed that job losses were minimized and delayed by many months due to the aggregate of the company's ARRA projects. As in the main case study, this supplier benefited by having a business model built around a core group of people. This company's business model includes a system of high automation and low labor costs, allowing the supplier to minimize job losses.

5.4 Mobility Case Study

5.4.1 Project Background

Contractor: Name Omitted for Anonymity, Central, TX
Award Amount: $7,507,830
Work Begun: 6/27/09
Scope of Work: Widen roadway, Burleson County, TX
Direct Employees: 23 (as of January 2010)
Direct Hours: 1,000 (as of January 2010)
Direct Payroll: $21,243.74 (as of January 2010)

The project studied is a road widening project in central Texas. According to the contractor, this is a safety project to convert a stretch of road from two lanes to four, with a divided median. TxDOT had this project planned for many years, but had not been able to fund it for construction. ARRA funds allowed this project to go to construction. It was one of the first state mobility projects let under ARRA during a special second letting in April 2009 for ARRA projects.

The winning bid for this project came in 50% below the Texas Department of Transportation estimate. Texas awarded more than 90% of their ARRA highway contracts below TxDOT estimates. In typical years, having contractors bid so far under the estimate would be very unusual. However, according to this contractor and others, the overall numbers of projects per firm at the beginning of 2009 were at critical lows across the board. Firms typically have a number of projects under way, as well as several in the pipeline. By doing so, the company is able to schedule work for a period of time and is able to budget for workers, equipment, and overhead. Without the promise of work to come, firms reduce their activity to meet coming work demand and on this particular project, the contractor would have had to let go approximately 20 workers.

The project broke ground in June 2009 and was scheduled for completion in the summer of 2010. The total project duration is approximately 14 months. This project is designed in two major phases. First, brand new eastbound lanes will be constructed. Then, traffic will be shifted onto these new lanes while the existing westbound lanes are re-built.

Typical of mobility projects, the major activities include clearing the right-of-way, reclaiming old pavement material, laying down foundations and base for new lanes, paving, signage, and transporting materials to and from the site. As the project is converting two lanes to four with a divided median, it also requires earth movement for embankment construction and structures for two new bridge sections. The project follows a typical road construction process with 800- to 2500-foot long sections of roadway at a time under construction. First earthwork, then subgrade preparation, followed by the concrete base, flex-base, then asphalt sealcoat with curing times between each phase. Each section takes about one month with finishing touches like striping, railing, and signage. Drainage and bridge structure sections are added as needed. For example, the eastbound bridge deck structure for this project took approximately 4 months: 2 months for earthwork and shaft drilling/construction followed by 2 months of pre-stressed concrete work for the decks. The bridge sections were approximately 1,000 feet in length.

5.4.2 Direct Job Impacts

The project cost is estimated to comprise of 60% material and subcontractor work, while 40% accounts for labor, overhead, and profit.

From the perspective of the prime contractor, the direct job impacts of this stimulus-funded project have been beneficial. As noted above, approximately 20 jobs with the prime contractor were saved as a result of being awarded this project. In addition, for the months of December, January, and February the prime contractor has reported on its ARRA Monthly Employment Report (form FHWA-1589) that this stimulus-funded project has paid for over 7,500 hours worth of labor with a payroll of almost $200,000. This report counts the workhours of both its contractors and the on-site subcontractors. Most of the workers employed by the prime contractor live and work locally, within a 10-mile radius of this project's location.

Feedback from subcontractors also indicates that this project helped retain workers. For example, one subcontractor located in central Texas is a disadvantaged business enterprise (DBE) that also received work from the ARRA-funded project. According to a company representative, the company was in the process of laying off workers because of a decline in awarded bids. For example, they won 24 bids in 2007, but only 13 in 2008. Finances became extremely tight for the company, and it downsized from 8 to 3 employees. However, in 2009 the number of winning bids increased to 24, with exactly half representing stimulus-funded projects. Feedback from DBEs also suggests that the number of projects has decreased resulting in extremely tight financial conditions.

5.4.3 Indirect Impacts

The company also produces some of the materials it uses in highway construction on site. For example, the firm estimated that it employs three people at its hot-mix plant, and four to five people in a laboratory to test the product. Figure 5.1 is the supplier chain for the project.

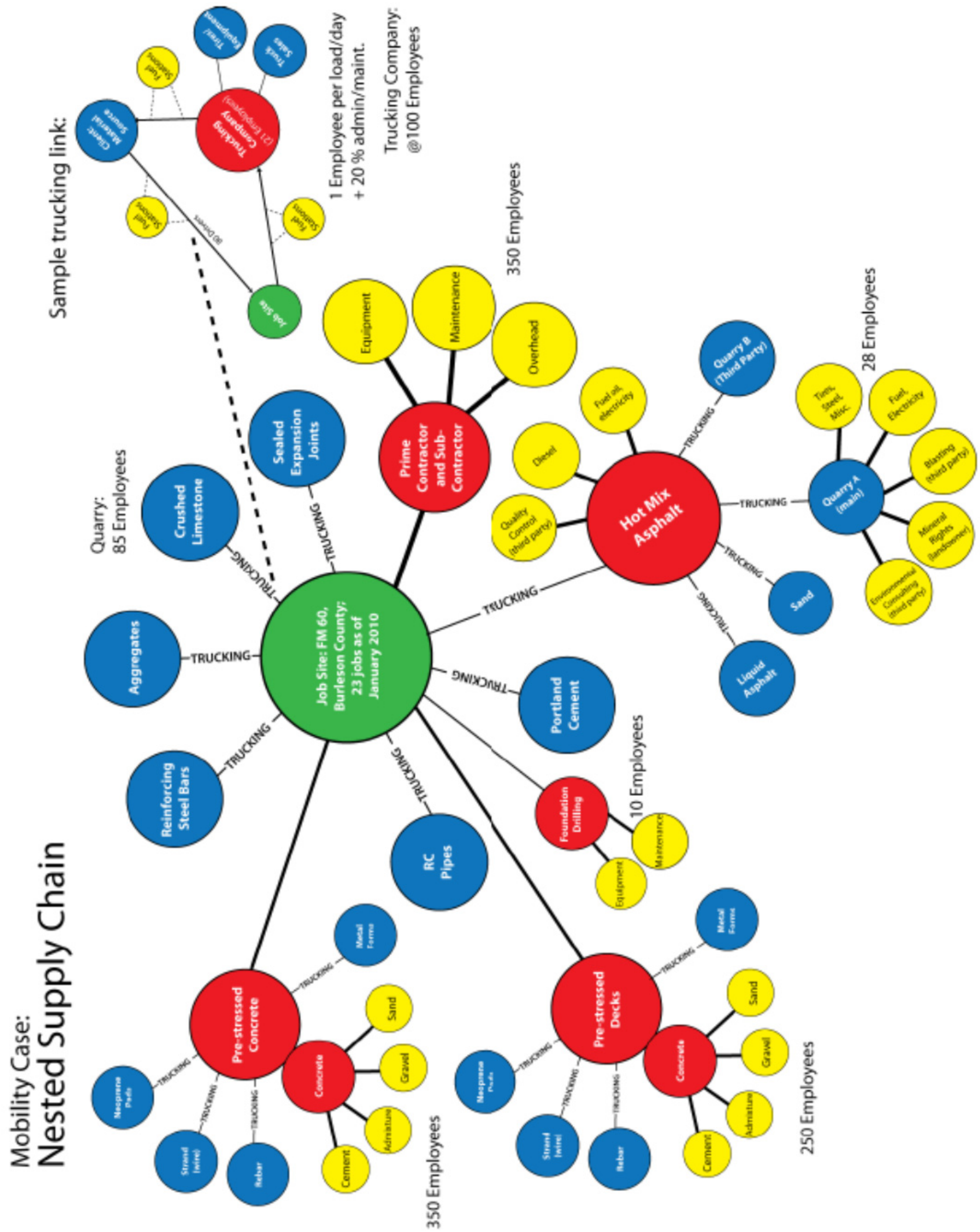


Figure 5.1: Mobility Case: Nested Supply Chain

The highway-related expenditures sustain employment for the direct contractor, but also generate revenue for each of the project contractor's particular suppliers and subcontractors. Likewise, these funds will trickle down to the firms that provide inputs for the supplier's product. The money spent on projects such as these also flow through to the surrounding communities where workers reside. The wages earned by residents eventually support businesses of all types and provide the basis for taxes that fund government services at the local, state, and national level.

5.4.1 Case Study Conclusions

While the positive effects of safer roads cannot be adequately quantified in terms of simple dollars, this stimulus project has resulted in employment for this particular contractor. Though this contractor did not hire new employees, it is clear that without this project their business would have been impaired, leading to layoffs. According to the Congressional Budget Office, for the third quarter of 2009 business growth overall would have been anywhere from 1.2 to 3.2% less without the stimulus.

Regarding the difference between TxDOT estimates and contractor bids, it appears as though contractors are bidding as close to "at-cost" as possible, which reduces the amount of labor employed. This is the paradox of stimulus spending in a down economy—because noone knows when the economy will improve, they hoard what they acquire. They make do with what is already owned and ‘tough’ it out. In the case of contractors, they utilize existing labor and equipment. The good news is that equipment wears out, and when conditions appear to be improving there will be significant replacement of equipment.

Chapter 6. Labor and Equipment Usage on ARRA Projects

6.1 Introduction

During the interviews and case studies it became clear that contractor usage of labor and equipment in the current economy was very different from the norm. This difference was reflected in the bids being received. TxDOT's ARRA projects were below the Engineer's Estimate by an average of 30%. One factor explaining this large difference is that TxDOT uses average bid prices for the preceding 12 months to prepare estimates, and prices up to 2008 were inflated by high fuel costs and material shortages. But even allowing for a 5–10% drop in real prices in 2009, the bidding suggested that contractors were cutting to the bone to win work. Not only was the average number of bidders per project higher, but anecdotally, more contractors were bidding out of their zones.

Thus, an analysis was undertaken to compare labor, material, and equipment usage on ARRA projects to expected norms. The norm chosen was the RS Means Estimating Data. RS Means is a nationally recognized provider of construction estimating data for heavy, light, and residential construction. Data is organized according to the American Institute of Architects standard work breakdown structure, providing productivity rates and labor, material, and equipment usage.

6.1.1 Objective of this Analysis

The objective of this analysis was to provide insights into what types of construction activities and projects are most labor-intensive, and how the construction industry makes decisions on increasing or reducing its labor force. The results could assist in estimating job creation in the construction industry from investments in transportation projects, specifically in the context of the 2008–2009 economic downturn and ARRA spending on 'shovel-ready' projects. The results could also support or disprove claims that spending on construction creates jobs, and thus be of use to transportation policy makers seeking support for additional funding.

6.1.2 Methodology

The monthly Form 1587 & Form 1585 supplied by TxDOT provided information on active ARRA projects in Texas. These reports provide Contract Number, Project Identification Number, Project Description, ARRA Funds to date, Total Funds, Contractor Name and their contact details, Total Employees, Total Work hours to date and Total Payroll to date. A sample of five ARRA projects was chosen for analysis. Direct labor, materials, and equipment required, under ideal economic conditions, to execute those projects were calculated using RS Means, and compared to actual usage on the projects. For each project the Contractor's Estimate Package (CEP) was studied. Figure 6.1 is an example of a CEP.

These CEPs were translated to Excel worksheets. The RS Means Heavy Construction Cost Database was used to prepare an 'ideal' estimate for each project. This consisted of analyzing all the items in the CEP and matching them with items in RS Means database. Wherever TxDOT items did not exactly match RS Means, similar activities were chosen.

CONTRACTOR'S ESTIMATE PACKAGE

REPORT DATE: 05/06/10

CONTRACT ID:	050402022	HIGHWAY:	SH 121
PROJECT:	STP 2009(485)ES	DISTRICT:	02
CONTRACT:	11093001	COUNTY:	TARRANT
AWARD AMOUNT:	$116,646,468.88	AREA ENGINEER:	Gregory Cedillo, P.E.
PROJECTED AMOUNT:	$117,107,718.88	AREA NUMBER:	054
ADJ. PROJECTED AMOUNT:	$117,107,718.88		
CONTRACTOR:	W.W. WEBBER, LLC		
ESTIMATE NUMBER:	0003	LETTING DATE:	11/05/2009
ESTIMATE PAID:	☑	AWARD DATE:	11/19/2009
ESTIMATE PERIOD:	03/26/2010 to 04/25/2010	NOTICE TO PROCEED DATE:	02/01/2010
ESTIMATE TYPE:	PROG	WORK BEGIN DATE:	03/15/2010
% COMPLETE:	6.96	ACCEPTED DATE:	00/00/0000
% TIME USED:	4.02	PHYSICAL WORK COMPLETION DATE:	00/00/0000
% RETAINAGE:	0.00		

RECAPITULATION

	TOTAL TO DATE	PREV TO DATE	THIS ESTIMATE
ITEM EARNINGS	$8,147,260.67	$459,189.13	$7,688,071.54
PARTICIPATING	$0.00	$0.00	$0.00
NON-PARTICIPATING	$8,147,260.67	$459,189.13	$7,688,071.54
RETAINAGE	$0.00	$0.00	$0.00
LIQUIDATED DAMAGES	$0.00	$0.00	$0.00
INCENTIVE	$0.00	$0.00	$0.00
DISINCENTIVE	$0.00	$0.00	$0.00
OTHER ADJUSTMENTS	$0.00	$0.00	$0.00
PAID TO CONTRACTOR	$8,147,260.67	$459,189.13	$7,688,071.54

CONTRACT ADJUSTMENTS THIS ESTIMATE

ADJUSTMENT DESCRIPTION:
ADJUSTMENT AMOUNT:
REMARKS:

There are no Contract Adjustments for this estimate

LINE ITEM ADJUSTMENTS THIS ESTIMATE

ADJUSTMENT DESCRIPTION:
ADJUSTMENT AMOUNT:
REMARKS:

There are no Line Item Adjustments for this estimate

CERTIFIED AS CORRECT AND ONE COPY HAS BEEN GIVEN TO THE CONTRACTOR

AREA/PROJECT ENGINEER

DATE

CONTRACT ID 050402022 ESTIMATE 0003 CONTRACTOR'S ESTIMATE PACKAGE Page 4 of 13

CONTRACT LINE ITEMS

PROJECT STP 2009(485)ES CONTROL 050402022
CATEGORY 001 DESCRIPTION ALL ITEMS

LINE NBR	ITEM CODE	SP NBR	DESCRIPTION	UNIT	UNIT PRICE	BID QUANTITY	NET CO QUANTITY	QTY PAID TO DATE	AMOUNT $
0060	01002002	002	PREPARING ROW	STA	15,000.000	105.000	0.000	32.00	480,000.00
0075	01042009	000	REMOVING CONC (RIPRAP)	SY	3.000	8,094.000	0.000	2,564.45	7,693.35
0110	01102001	000	EXCAVATION (ROADWAY)	CY	6.000	3,105,230.000	0.000	40,196.00	241,176.00
0115	01102003	000	EXCAVATION (SPECIAL)	CY	5.000	584,945.000	0.000	193,788.00	968,940.00
1035	05002001	005	MOBILIZATION	LS	11,000,000.000	1.000	0.000	0.50	5,500,000.00
1040	05022001	033	BARRICADES, SIGNS AND TRAFFIC HANDLING	MO	25,000.000	35.000	0.000	2.00	50,000.00
1055	05062016	010	CONSTRUCTION EXITS (INSTALL) (TY 1)	SY	14.270	5,766.000	0.000	445.76	6,361.00
1115	05122048	002	PORT CTB (FUR & INST)(F-SHAPE)(TY 1)	LF	30.000	24,810.000	0.000	17,430.00	522,900.00
1120	05122050	002	PORT CTB (MOVE)(F-SHAPE)(TY 1)	LF	1.710	68,400.000	0.000	270.00	461.70
1235	05452001	000	CRASH CUSH ATTEN (INSTL)	EA	20,004.440	17.000	0.000	6.00	120,026.64
1240	05452002	000	CRASH CUSH ATTEN (MOVE & RESET)	EA	1,420.000	30.000	0.000	1.00	1,420.00
1300	06102072	010	REMOVE RDWY ILL ASSEM	EA	275.000	33.000	0.000	6.00	1,650.00
1550	06442060	000	REMOVE SM RD SN SUP & AM	EA	140.180	128.000	0.000	17.00	2,383.06
1665	06622064	000	WK ZN PAV MRK REMOV (W) 4" (BRK)	LF	0.490	12,355.000	0.000	13,850.00	6,786.50
1670	06622067	000	WK ZN PAV MRK REMOV (W) 4" (SLD)	LF	0.490	85,642.000	0.000	21,581.00	10,574.69
1675	06622099	000	WK ZN PAV MRK REMOV (Y) 4" (SLD)	LF	0.490	88,149.000	0.000	22,393.00	10,972.57
1840	06772001	000	ELIM EXT PAV MRK & MRKS (4")	LF	0.320	34,140.000	0.000	41,215.00	13,188.80
2005	41162001	000	SOIL NAIL ANCHORS	LF	13.000	24,240.000	0.000	2,400.00	31,200.00
2015	50492002	000	BIODGRD EROSION CONTROL LOGS (18" DIA)	LF	2.710	26,785.000	0.000	5,517.00	14,951.07
2030	68342001	000	PORTABLE CHANGEABLE MESSAGE SIGN	DAY	300.000	1,080.000	0.000	12.00	3,600.00
2110	96012001		MATERIAL ON HAND	DOL	1.000	1,000.000	0.000	152,975.29	152,975.29
								Category Subtotal	8,147,260.67

PROJECT STP 2009(485)ES CONTROL 050402022
CATEGORY 001 DESCRIPTION ALL ITEMS

LINE NBR	ITEM CODE	SP NBR	DESCRIPTION	UNIT	UNIT PRICE	BID QUANTITY	NET CO QUANTITY	QTY PAID TO DATE	AMOUNT ($)
0065	01002009	002	PREPARING ROW (TREE) (6" TO 24" DIA)	EA	45.000	752.000	0.000	0.000	0.00
0070	01042001	000	REMOVING CONC (PAV)	SY	3.000	144,463.000	0.000	0.000	0.00
0080	01042015	000	REMOVING CONC (SIDEWALKS)	SY	6.000	173.000	0.000	0.000	0.00
0085	01042017	000	REMOVING CONC (DRIVEWAYS)	SY	5.000	4,842.000	0.000	0.000	0.00
0090	01042021	000	REMOVING CONC (CURB)	LF	1.000	1,940.000	0.000	0.000	0.00
0095	01042023	000	REMOVING CONC (CTB)	LF	3.000	3,966.000	0.000	0.000	0.00
0100	01042024	000	REMOVING CONC (RETAINING WALLS)	SY	7.000	616.000	0.000	0.000	0.00
0105	01052058	000	REMOVING STAB BASE & ASPH PAV (10"-12")	SY	5.000	4,355.000	0.000	0.000	0.00
0120	01322001	000	EMBANKMENT (FINAL)(ORD COMP)(TY A)	CY	4.000	1,500.000	0.000	0.000	0.00
0125	01322002	000	EMBANKMENT (FINAL)(DENS CONT)(TY A)	CY	2.000	156,174.000	0.000	0.000	0.00
0130	01322004	000	EMBANKMENT (FINAL)(DENS CONT)(TY B)	CY	3.500	8,494.000	0.000	0.000	0.00
0135	01322006	000	EMBANKMENT (FINAL)(DENS CONT)(TY C)	CY	3.000	468,059.000	0.000	0.000	0.00
0140	01612008	001	EROSION CONTROL COMPOST (2")	SY	0.100	825,317.000	0.000	0.000	0.00
0145	01612014	001	COMPOST MANUF TOPSOIL (BOS OR PB) (4")	SY	0.520	763,047.000	0.000	0.000	0.00
0150	01622002	000	BLOCK SODDING	SY	1.300	531,465.000	0.000	0.000	0.00

Figure 6.1: Example of a Contractor's Estimate Package (CEP)

The data computed from RS Means were:

1. Total (Estimated) Work hours for work-to-date and for completion

2. Material Cost for work-to-date and for completion
3. Labor Cost for work-to-date and for completion
4. Equipment Cost for work-to-date and for completion
5. Total Cost per RS Means including Overheads and Profit (the normal cost)
6. Estimated Cost of labor, material and equipment for work-to date.

The CEP items were divided into standard work groups to better facilitate interpretation:

1. Demolition & Site Preparation
2. Earthwork
3. Site Improvement
4. Surface Preparation & Asphalting
5. Foundations
6. Concreting
7. Drainage Works
8. Electrical Supply & Installation

A resulting sample spreadsheet for one such project after grouping various items and calculating the total cost parameters is shown in Table 6.1.

Table 6.1: Cost Data for Sample Project

Description	Total bid amount ($)	Amount ($) paid to date	RS Means Cost to date ($)	RS Means Total cost ($)	Work hours (bid qty)	Work hours (to date)
Demolition & Site Preparation	48,483	31,505	139,653	181,827	3,289	2,745
Surface Preparation & Asphalting	129,361	75,047	41,966	77,162	321	146
Earthwork	1,231,886	950,185	732,946	923,654	1,732	1,535
Foundations	1,733,489	1,650,863	1,137,497	1,195,208	8,334	7,902
Cast In-Situ Concreting	3,798,825	2,820,357	1,732,267	2,328,814	30,478	22,772
Drainage Works	618,136	75,801	64,830	727,049	8,700	660
Site Improvement	1,541,489	746,320	226,670	214,265	1,015	963
Total	9,101,670	6,350,078	4,075,829	5,647,980	53,870	36,723

6.1.3 Results

Similar analysis was carried out for all the projects and plots were generated for various analyses. Figures 6.2 to 6.6 show "Total Bid Amount" and "RS Means Total Estimated Cost" for each project. It is not clear that there is a significant difference between the RS Means total estimate and the actual total bid. While this observation gives comfort that the RS Means estimate is a good number, it does not conform to some anecdotes that winning ARRA bids are below cost.

However, it is seen that for some work groups there are large differences between the RS Means estimate and the actual bid cost. Figures 6.7 to 6.13 are the respective plots for Demolition, Surface Preparation & Asphalting, Earthwork, Foundations, Cast In-situ Concreting, Drainage Works, and Site Improvement for the five projects. These figures show that Demolition is being bid significantly lower than expected, but the other work groups are about what is expected.

The next part of the analysis was to compare the RS Means expected estimate of work completed to actual. Figures 6.14 to 6.20 show “Estimated cost as per RS Means” vs. “Amount paid out for work executed till date” for the seven work groups. Again, Demolition is being paid out lower than expected, but the other work groups are approximately as expected.

The final part of the analysis was to calculate the total Equipment, Labor and Material (ELM) usage (in terms of cost)—both estimated to complete and for quantities executed till date. This was a necessary analysis because in TxDOT projects contractors bid a full price for each item, with no breakdown of labor, material, and equipment. Figure 6.21 is the chart for work completed to date in each of the five projects, and Figure 6.22 is for the total cost for each of the five projects. Figure 6.21 shows that, for work completed to date, labor comprises approximately 30% of costs, materials 40–50%, and equipment 20–30%. The high material and equipment components of these projects explain why many jobs are not being created. Increasing automation in construction is reducing the need for labor. But high material use suggests that more jobs are being created off-site in supplier plants and factories.

The outlook on completing these projects is also disheartening for those who expected ARRA funds to create jobs. As seen in Figure 6.22, the labor component remains around 30%, with materials and equipment exchanging the majority. A material and equipment component of 70% suggests that most of the ARRA funds are going to materials suppliers and equipment expenditures. Ultimately, when equipment is replaced, jobs will be supported in equipment manufacturing plants.

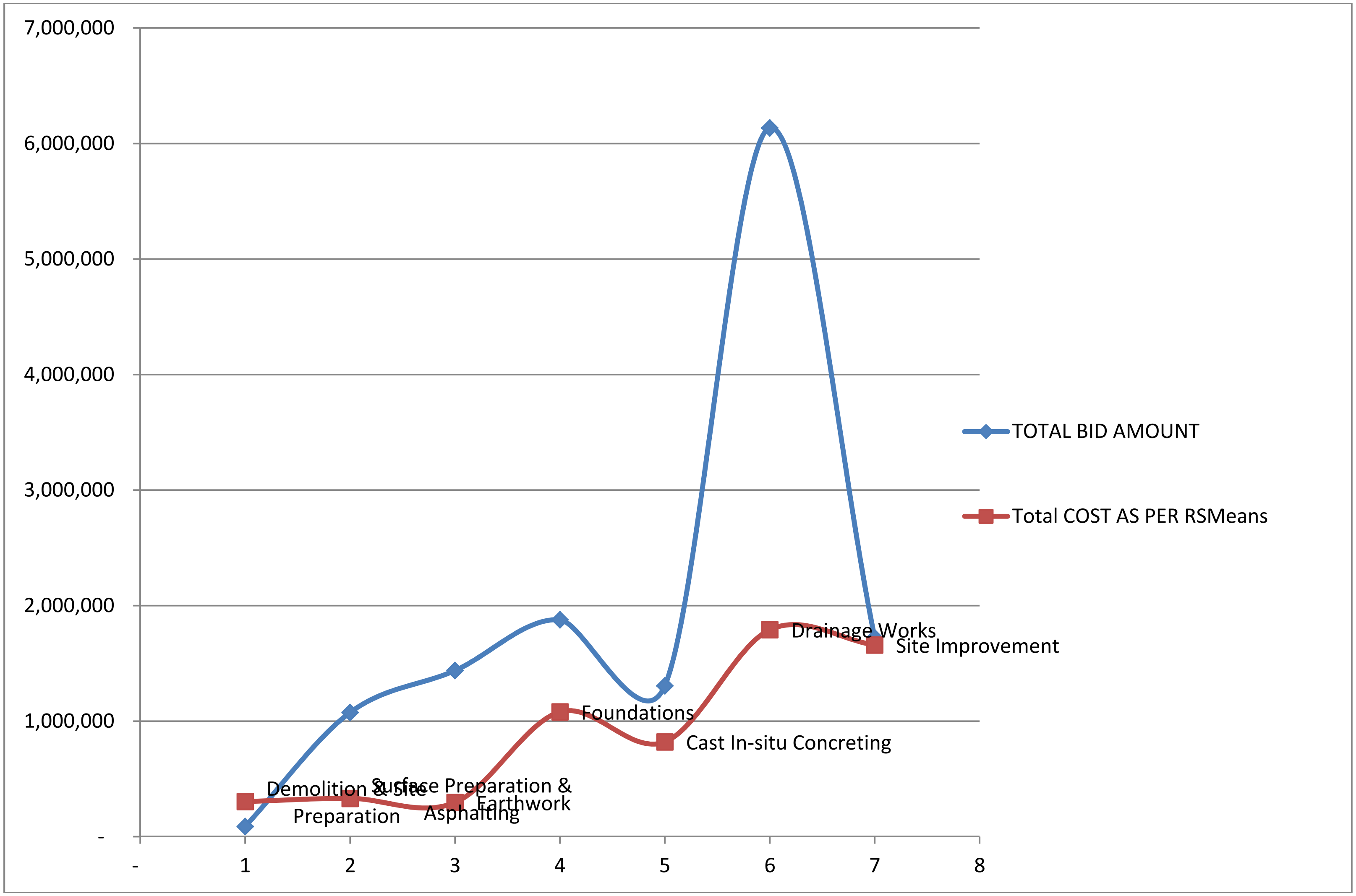


Figure 6.2: Total Bid Amount vs. Total Estimated Cost for Proj. No. 027107242

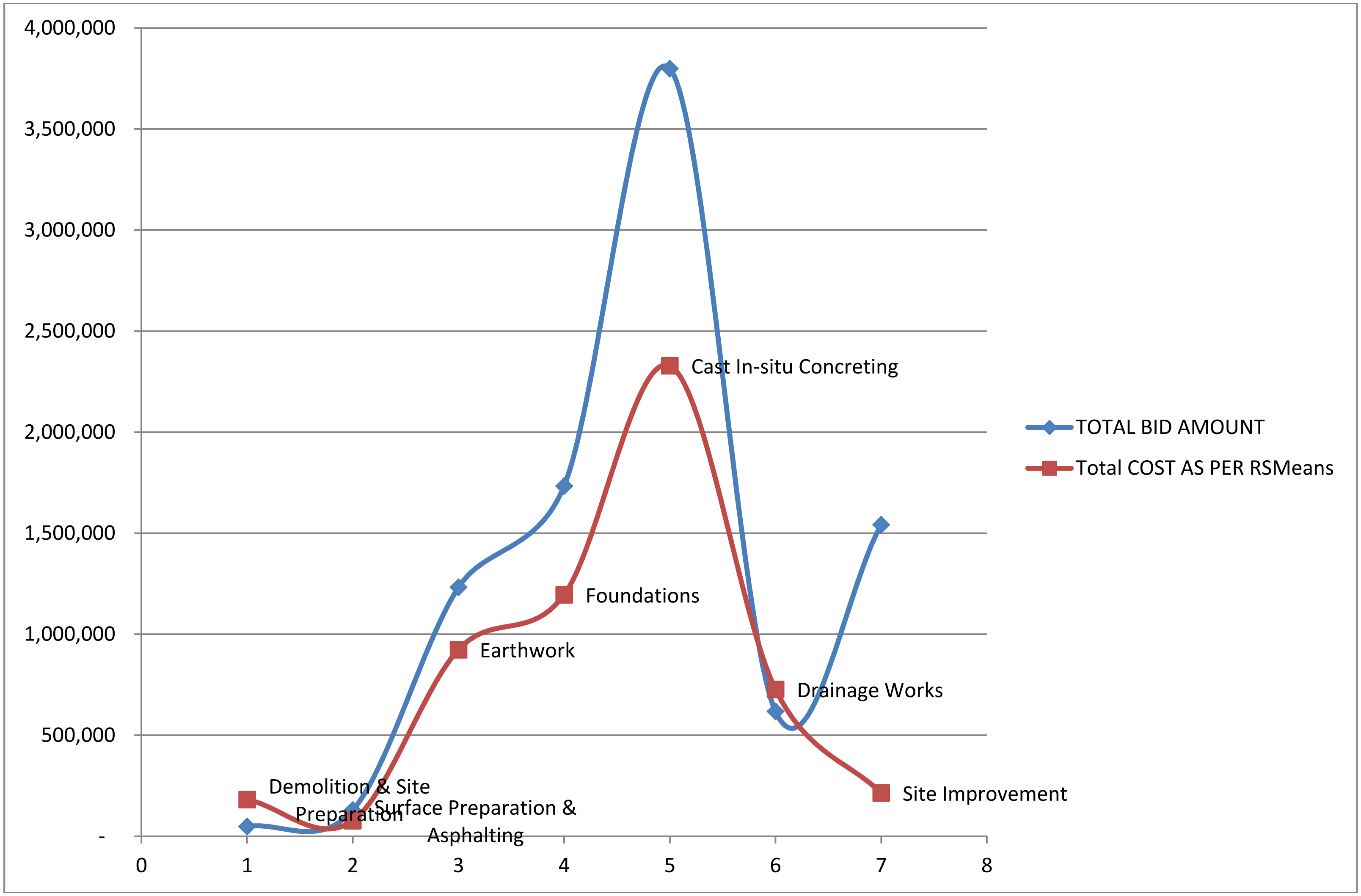


Figure 6.3: Total Bid Amount vs. Total Estimated Cost for Proj. No. 019607027

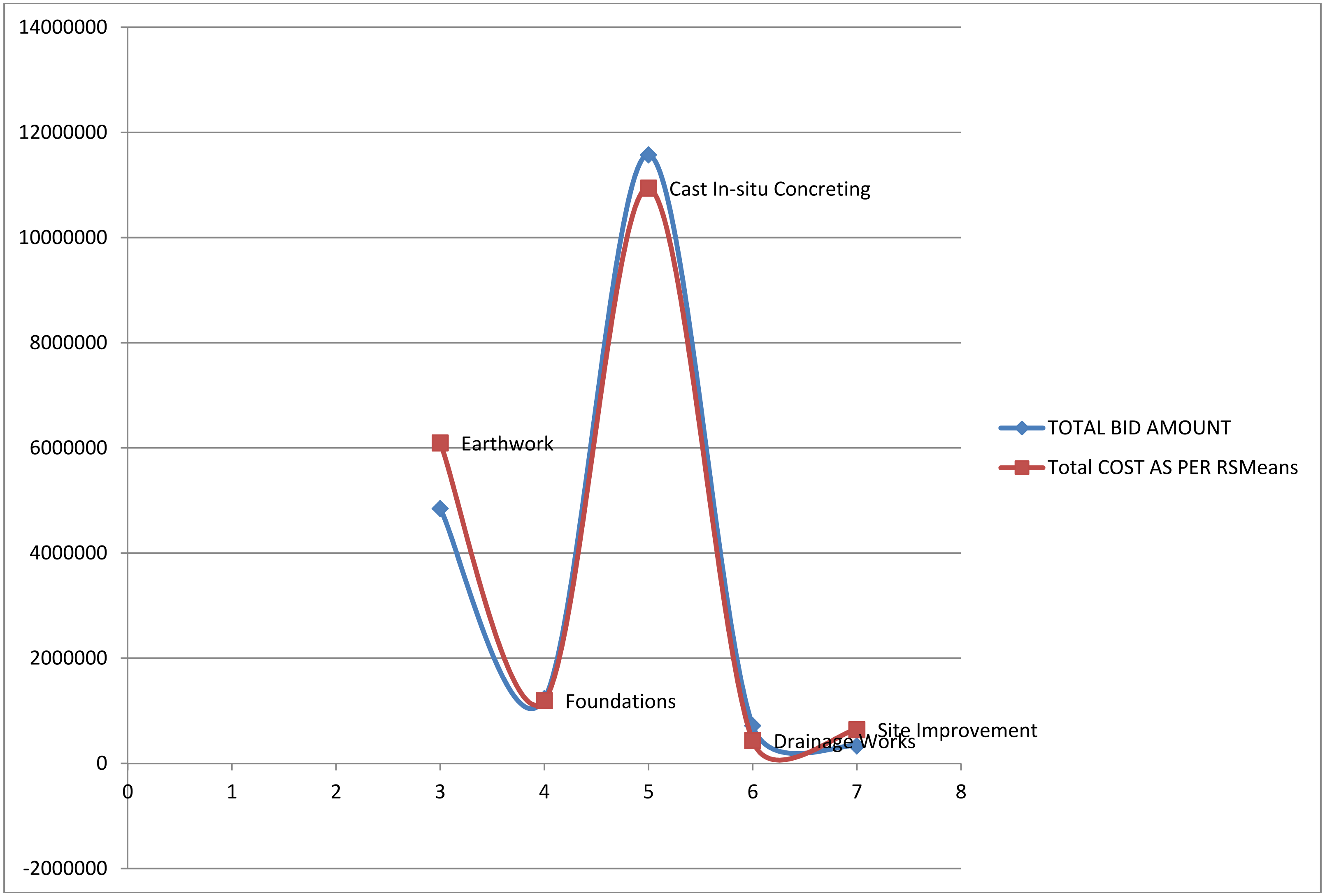


Figure 6.4: Total Bid Amount vs. Total Estimated Cost for Proj. No. 348701004

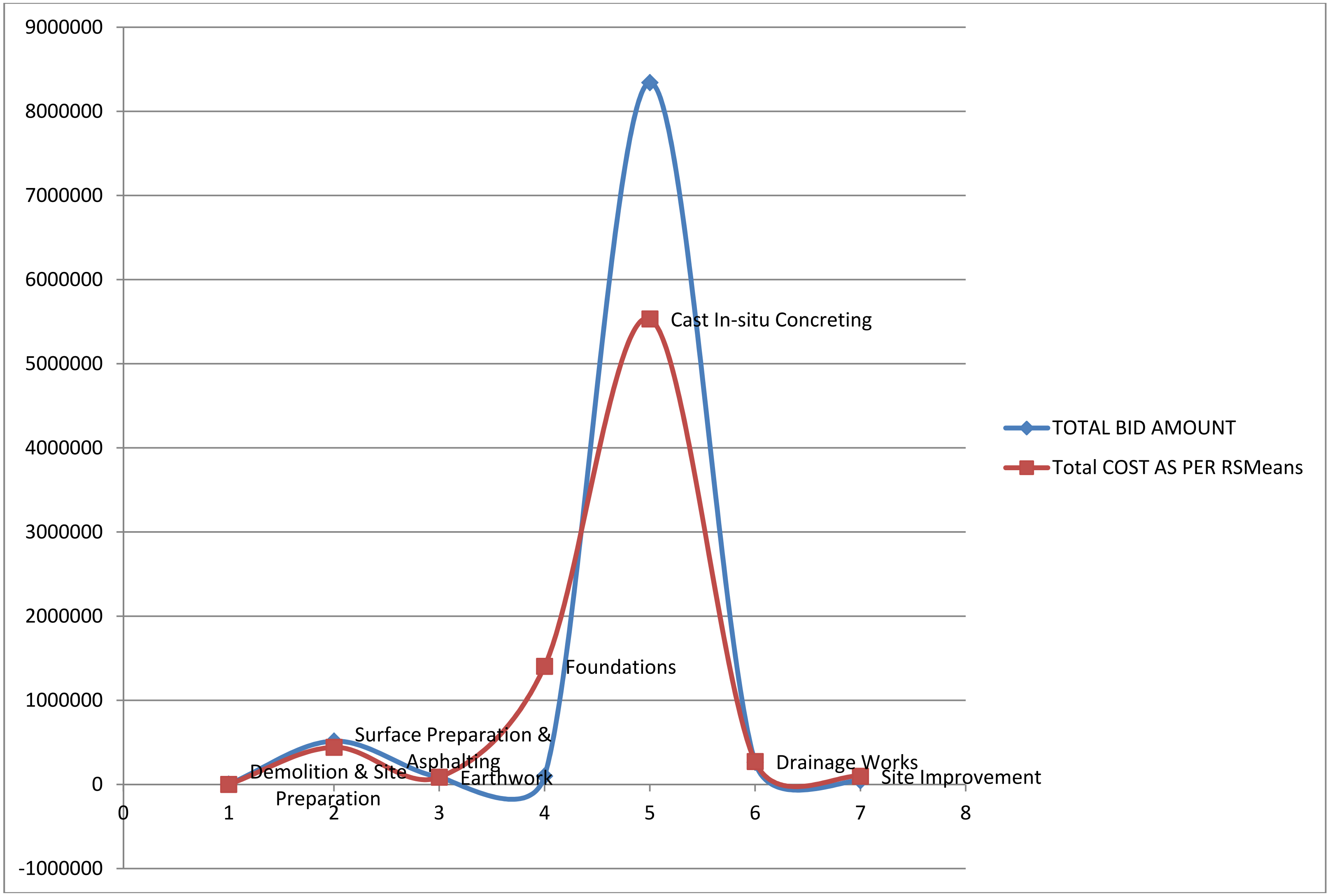


Figure 6.5: Total Bid Amount vs. Total Estimated Cost for Proj. No. 325602074

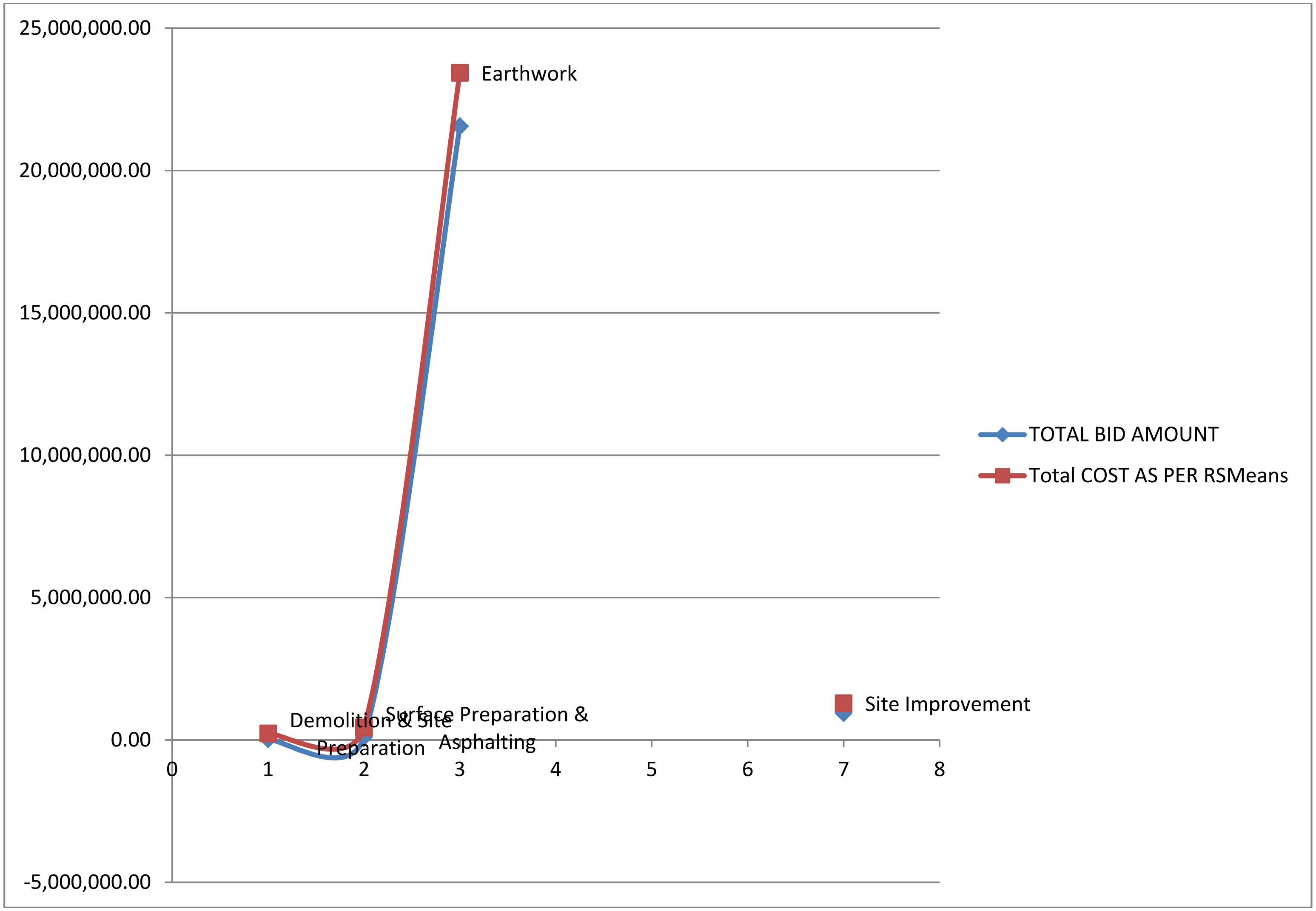


Figure 6.6: Total Bid Amount vs. Total Estimated Cost for Proj. No. 050402022

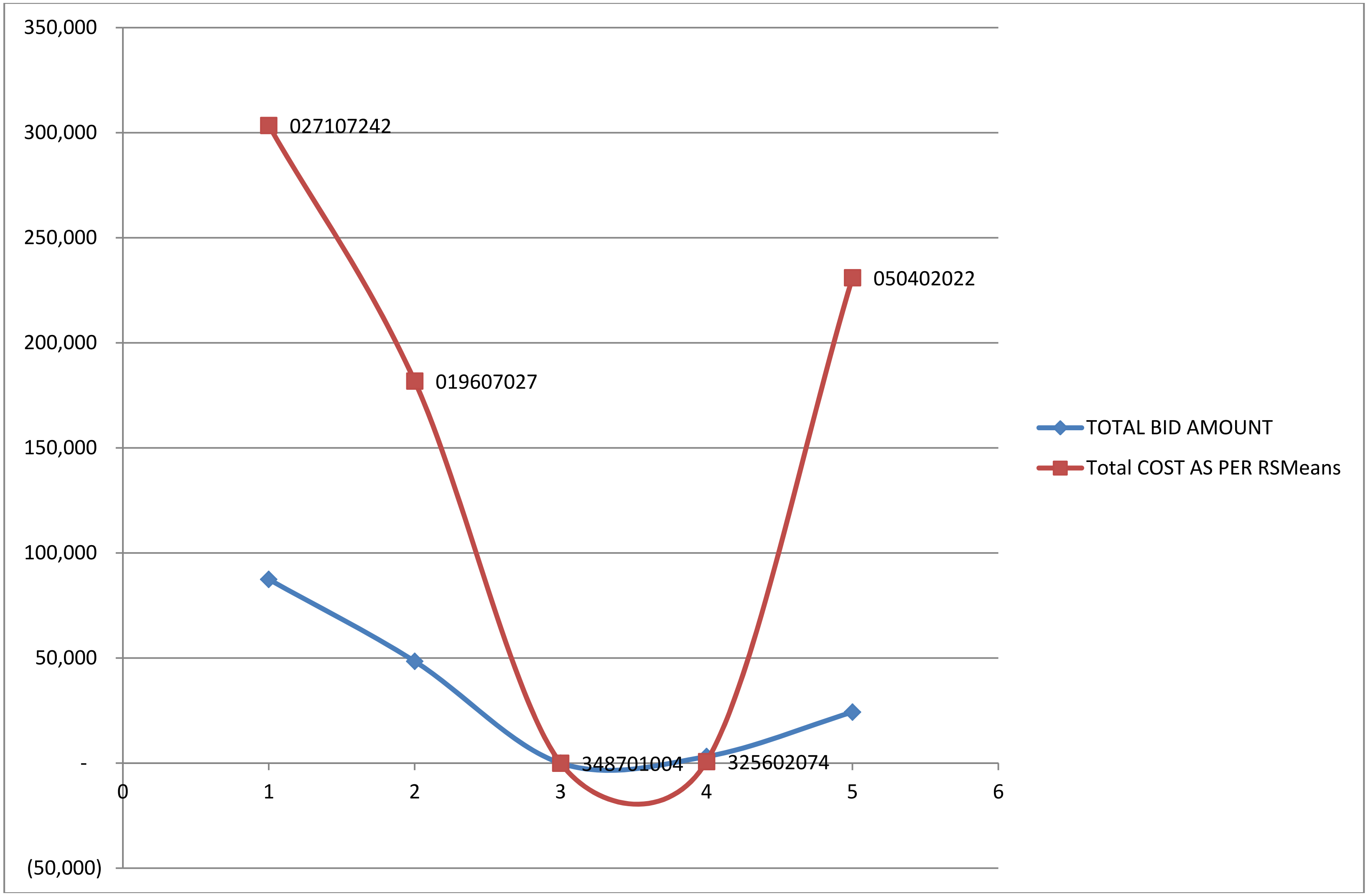


Figure 6.7: Total Bid Amount vs. Total Estimated Cost for Demolition activity

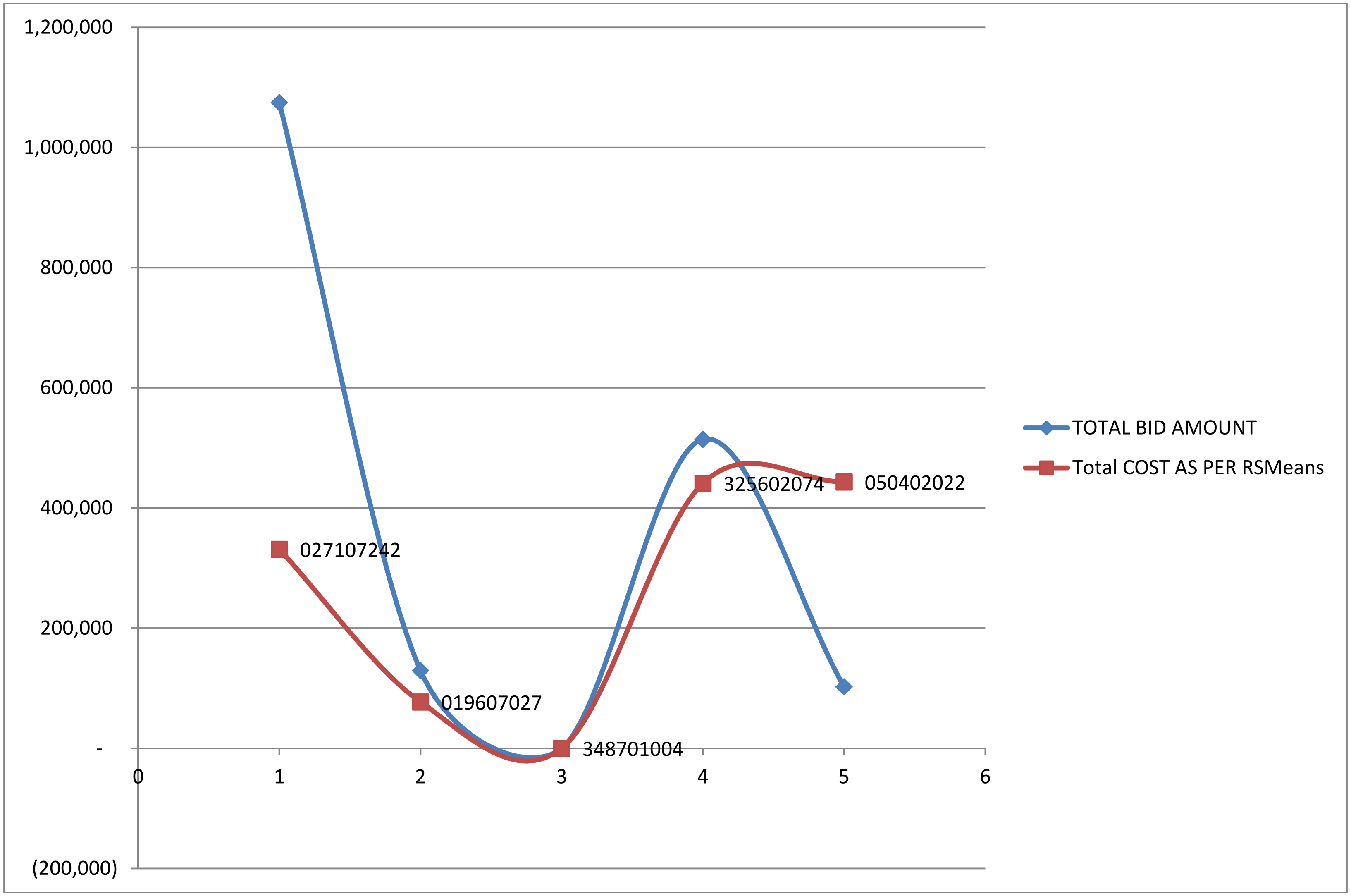


Figure 6.8: Total Bid Amount vs. Total Estimated Cost for Surface Preparation & Asphalting activity

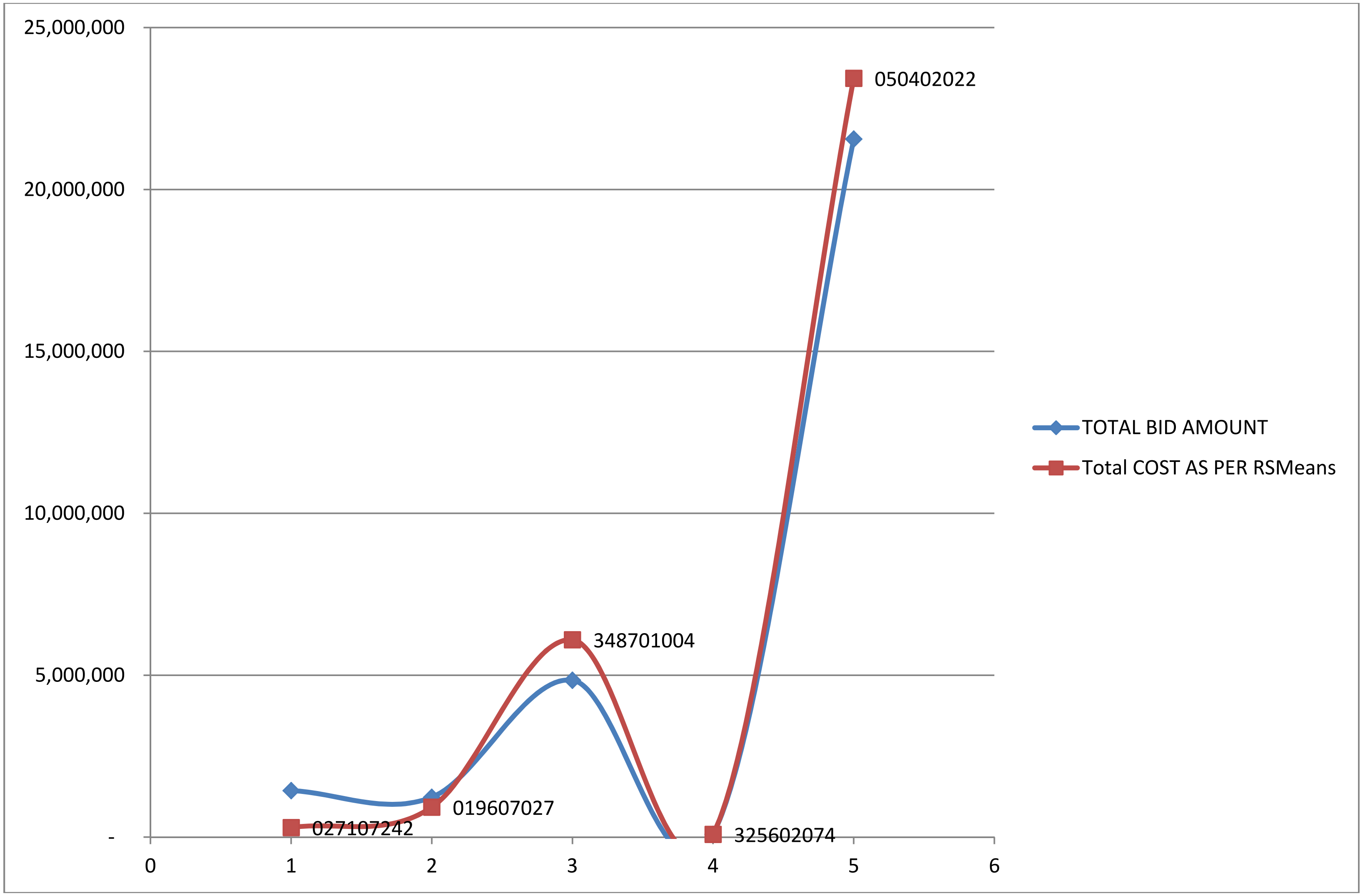


Figure 6.9: Total Bid Amount vs. Total Estimated Cost for Earthwork activity

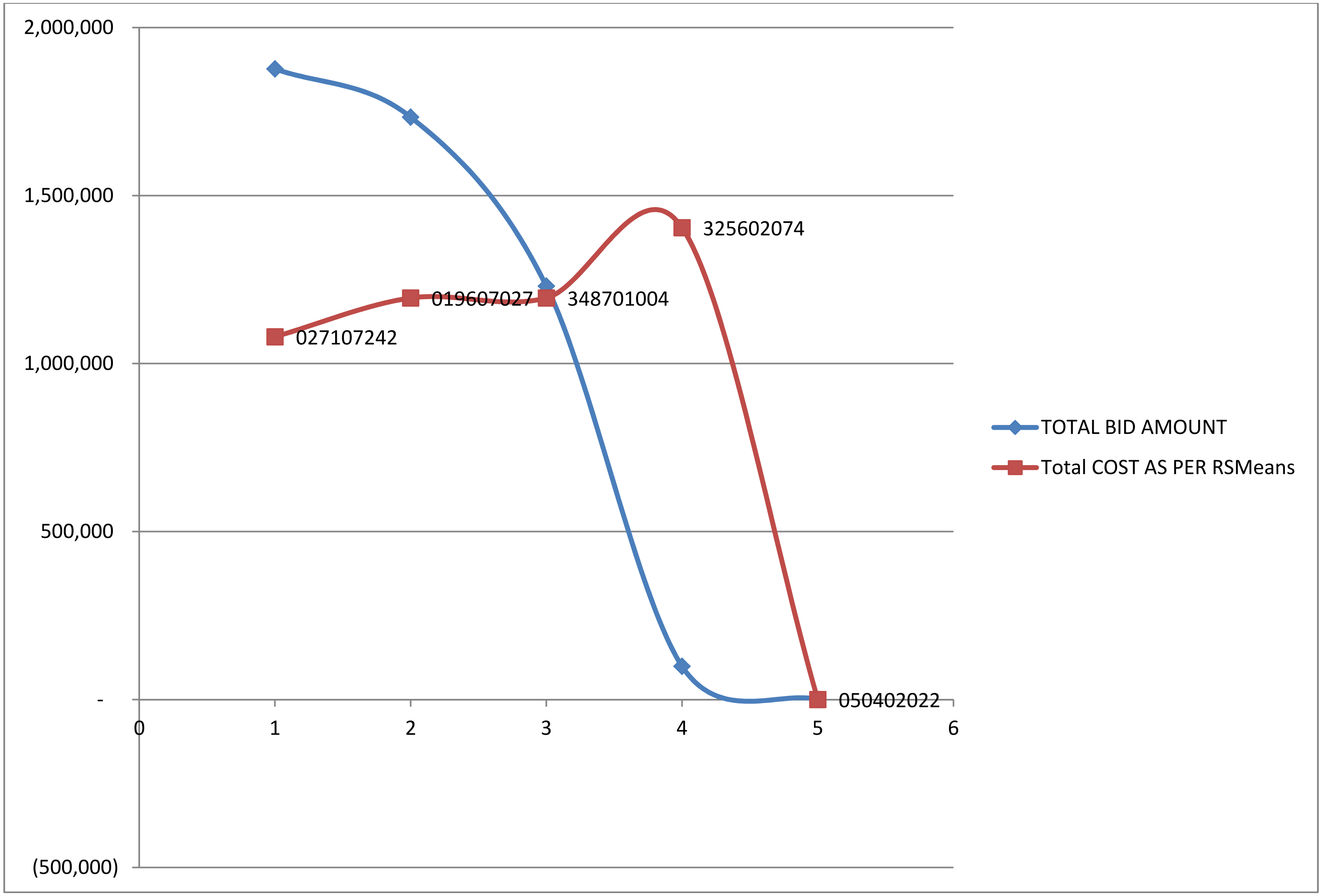


Figure 6.10: Total Bid Amount vs. Total Estimated Cost for Foundation activity

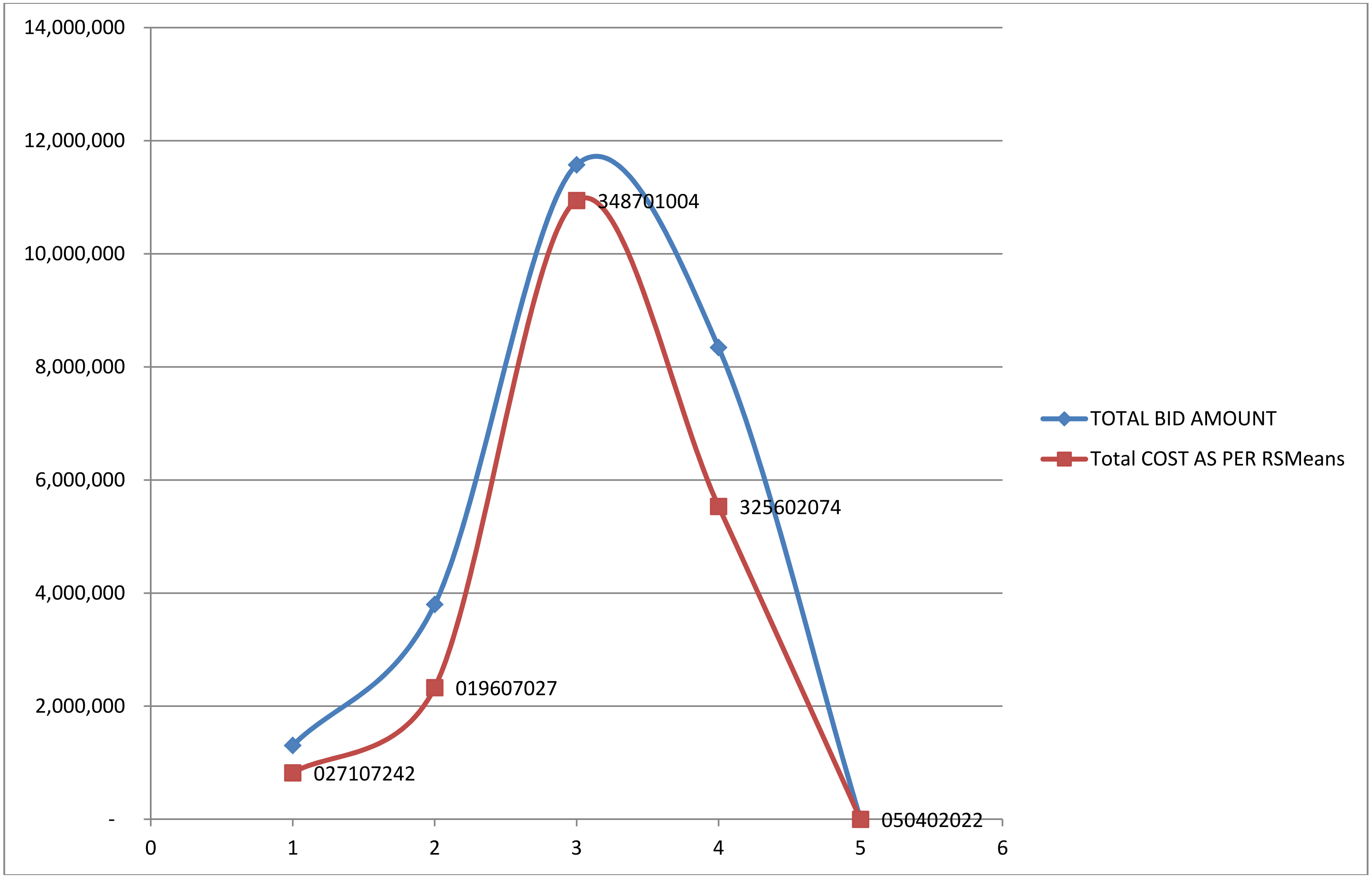


Figure 6.11: Total Bid Amount vs. Total Estimated Cost for Concreting activity

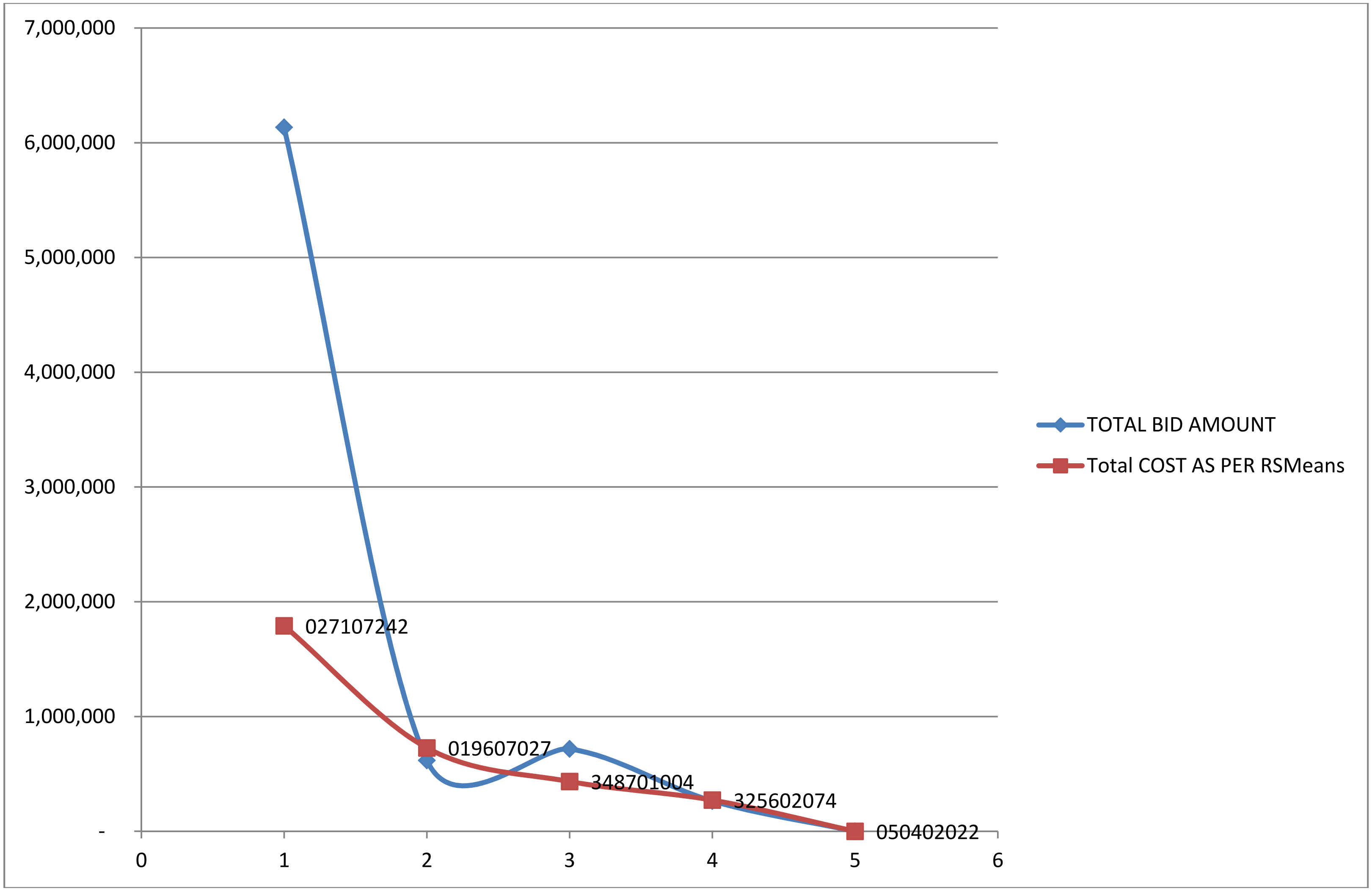


Figure 6.12: Total Bid Amount vs. Total Estimated Cost for Drainage works

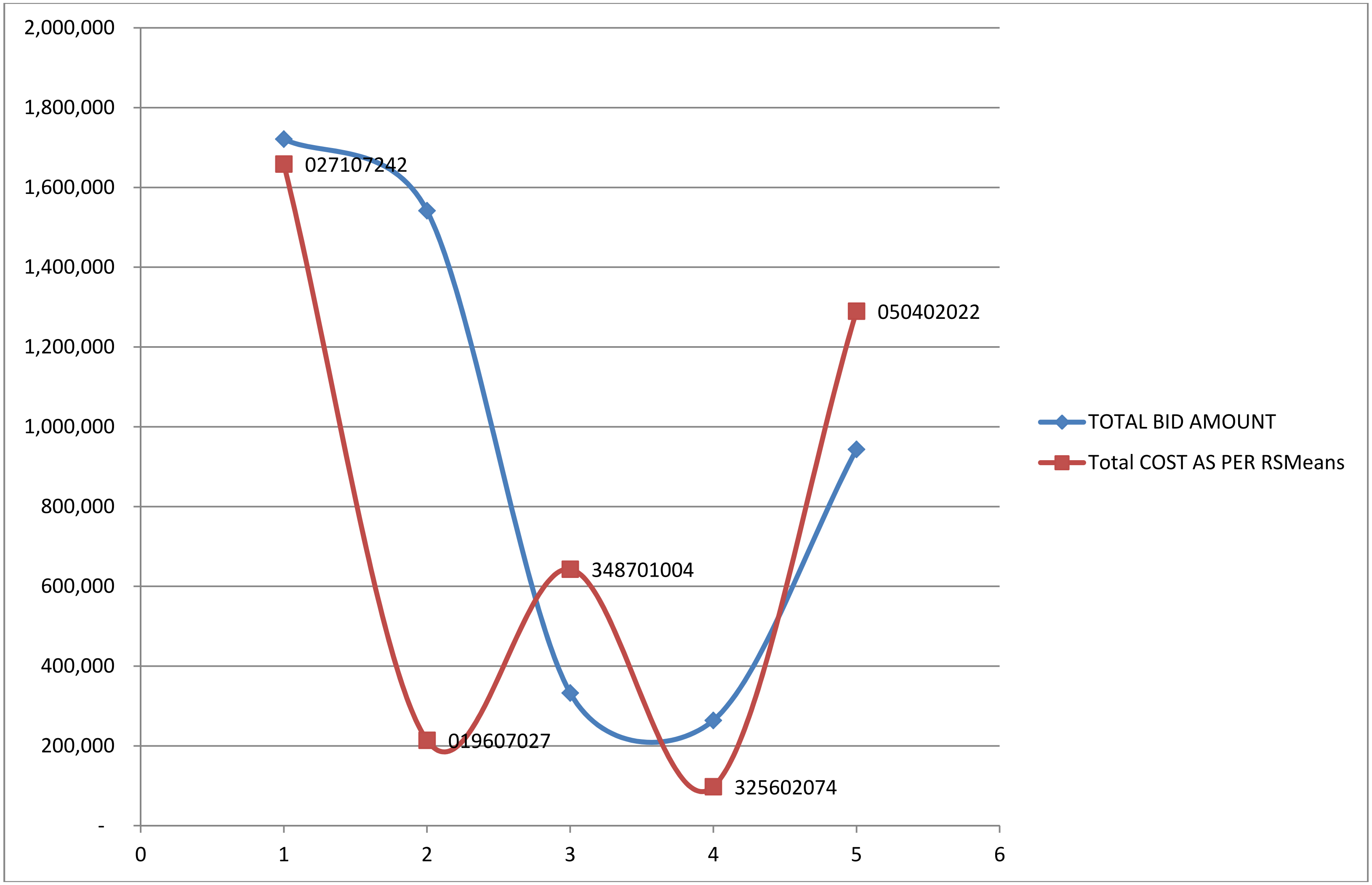


Figure 6.13: Total Bid Amount vs. Total Estimated Cost for Site Improvement works

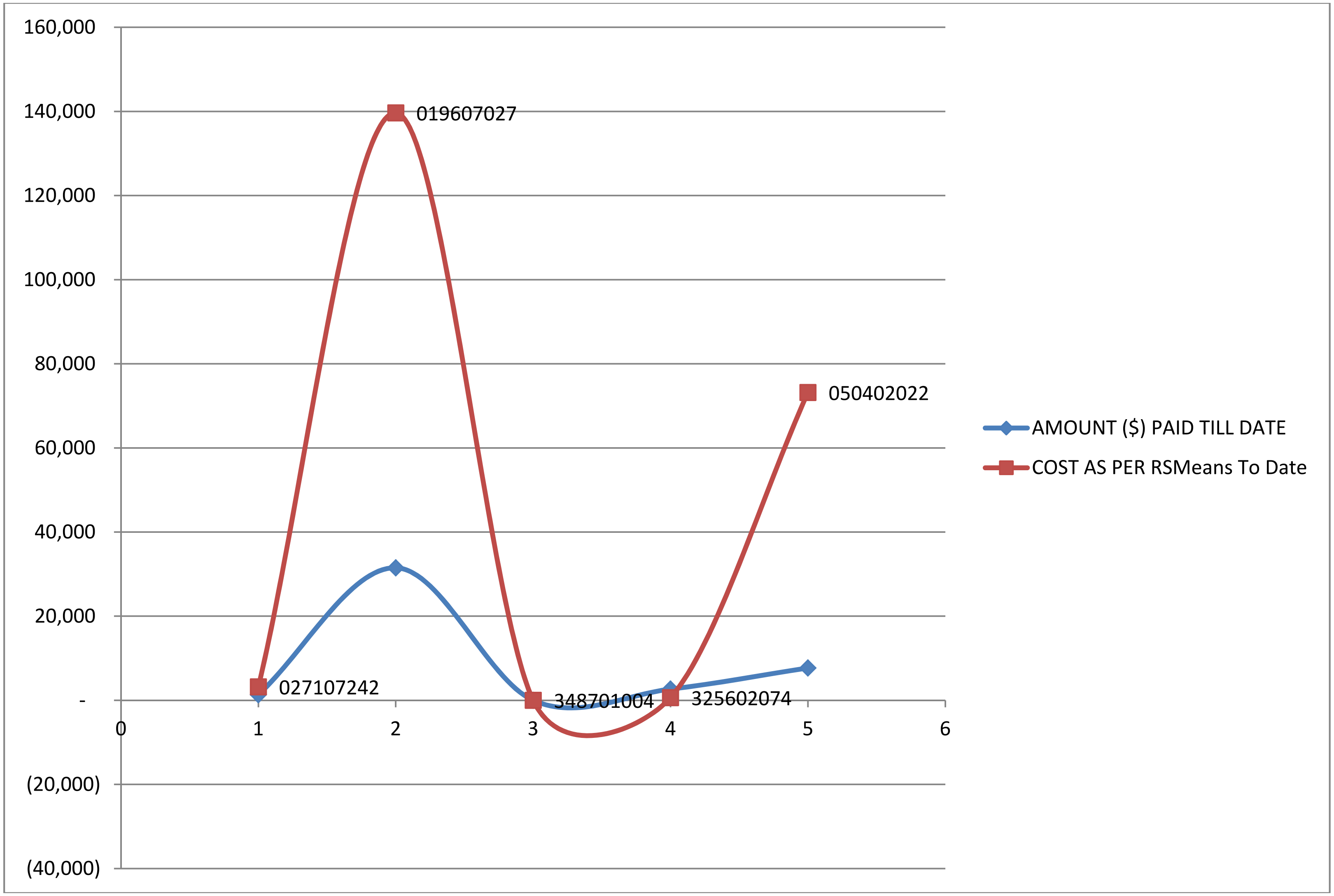


Figure 6.14: Estimated Cost (to date) vs. Amount Paid (to date) for Demolition works

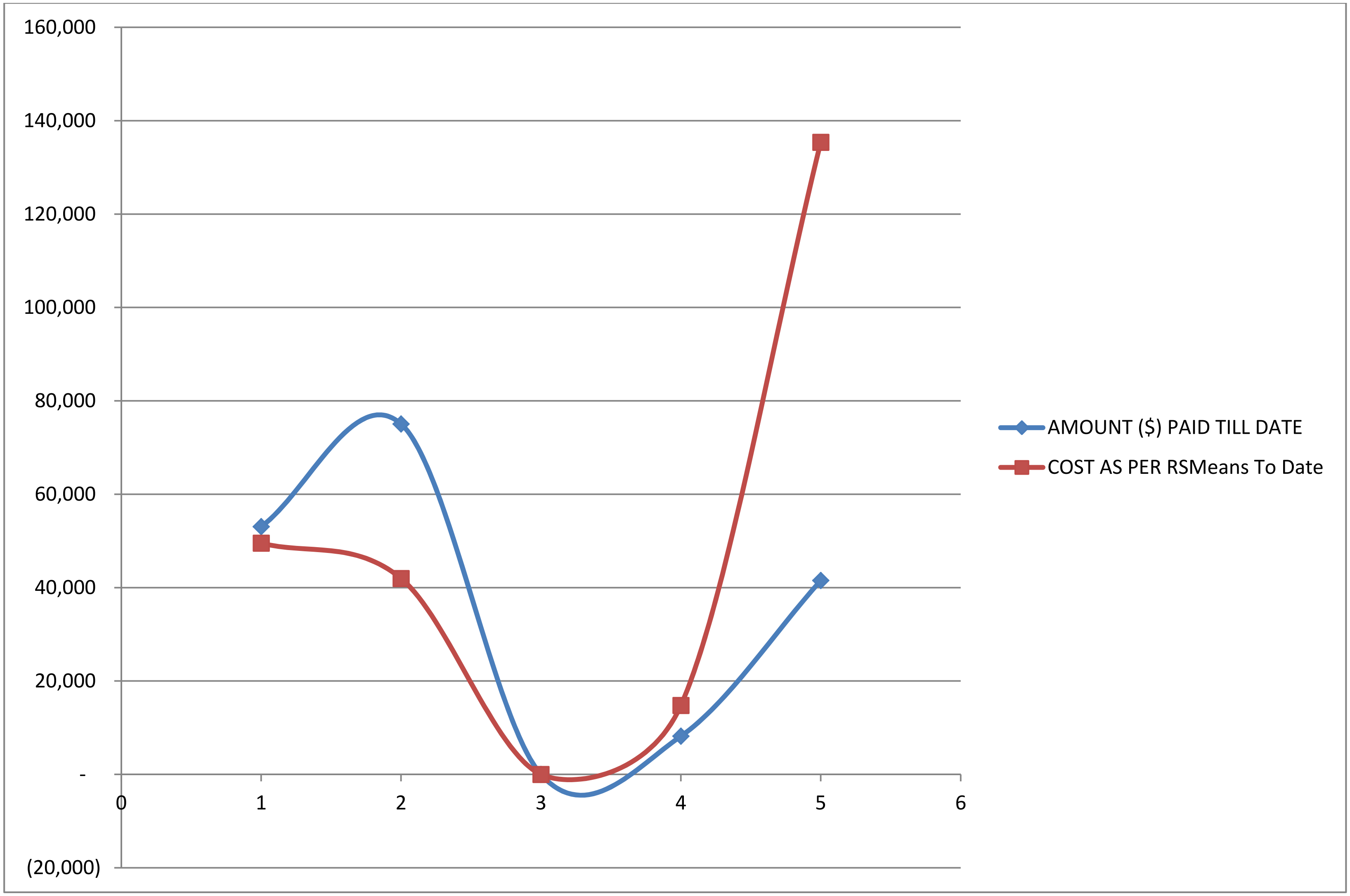


Figure 6.15: Estimated Cost (to date) vs. Amount Paid (to date) for Surface Preparation & Asphalting works

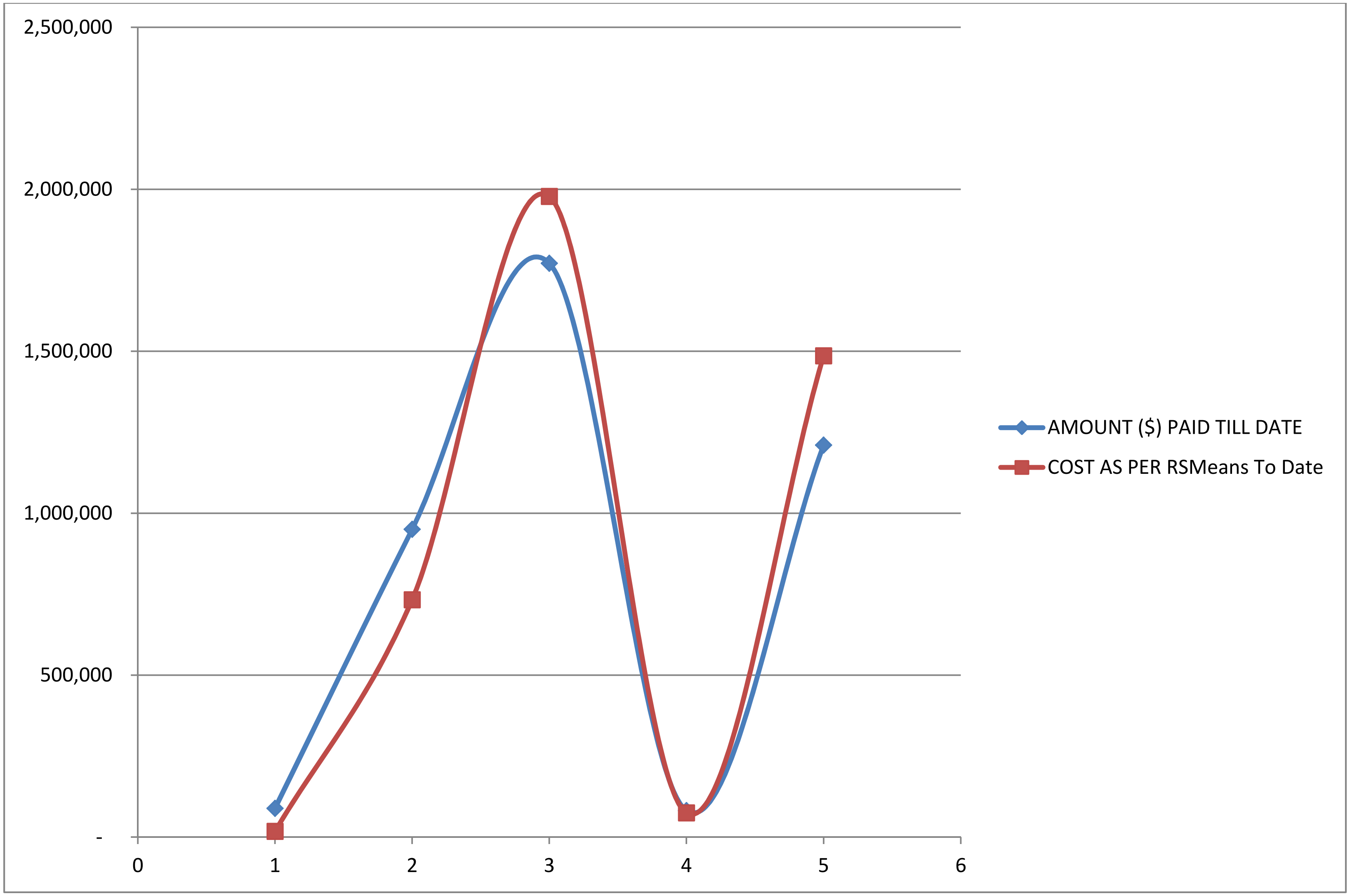


Figure 6.16: Estimated Cost (to date) vs. Amount Paid (to date) for Earthwork

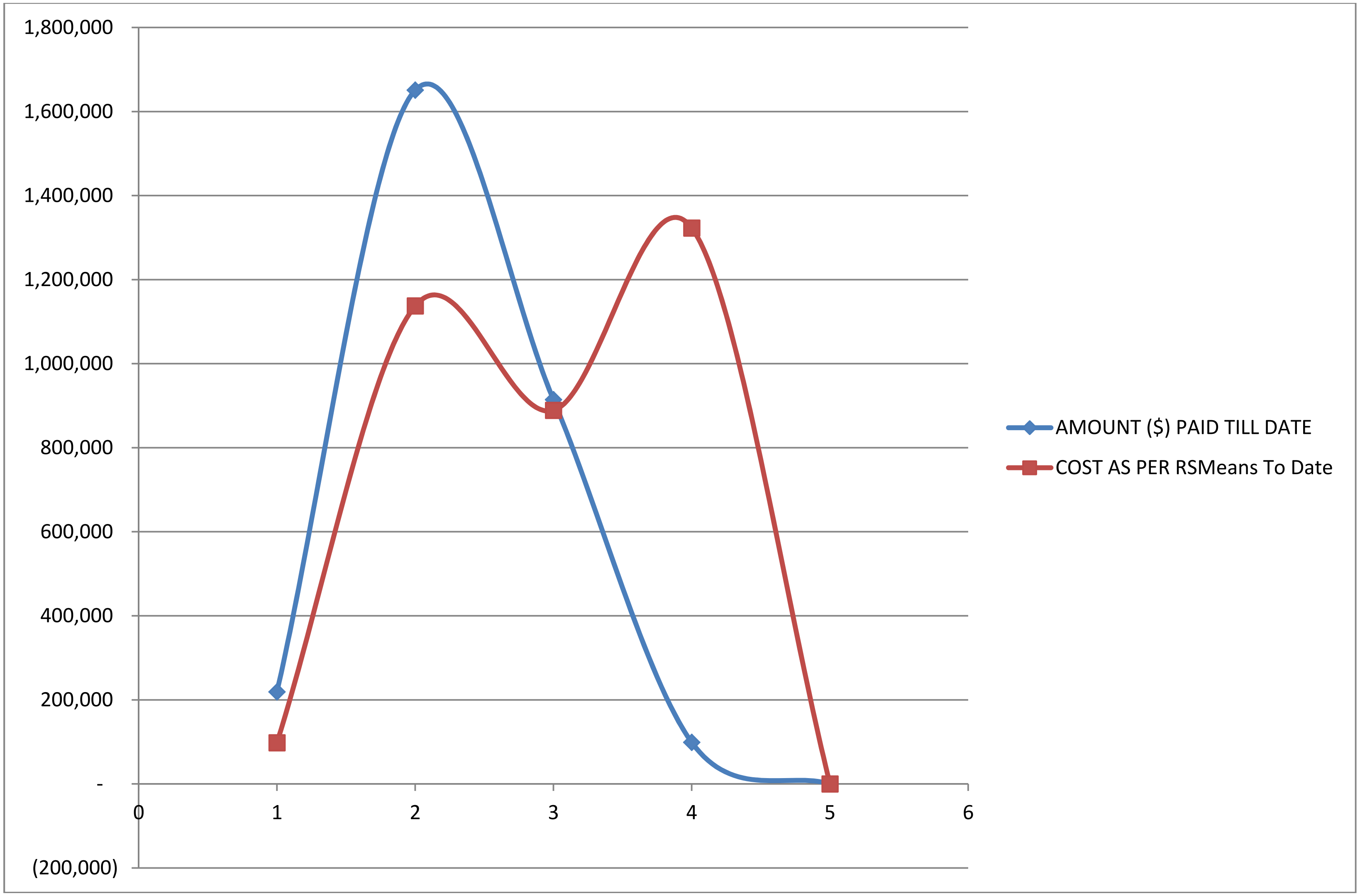


Figure 6.17: Estimated Cost (to date) vs. Amount Paid (to date) for Foundation work

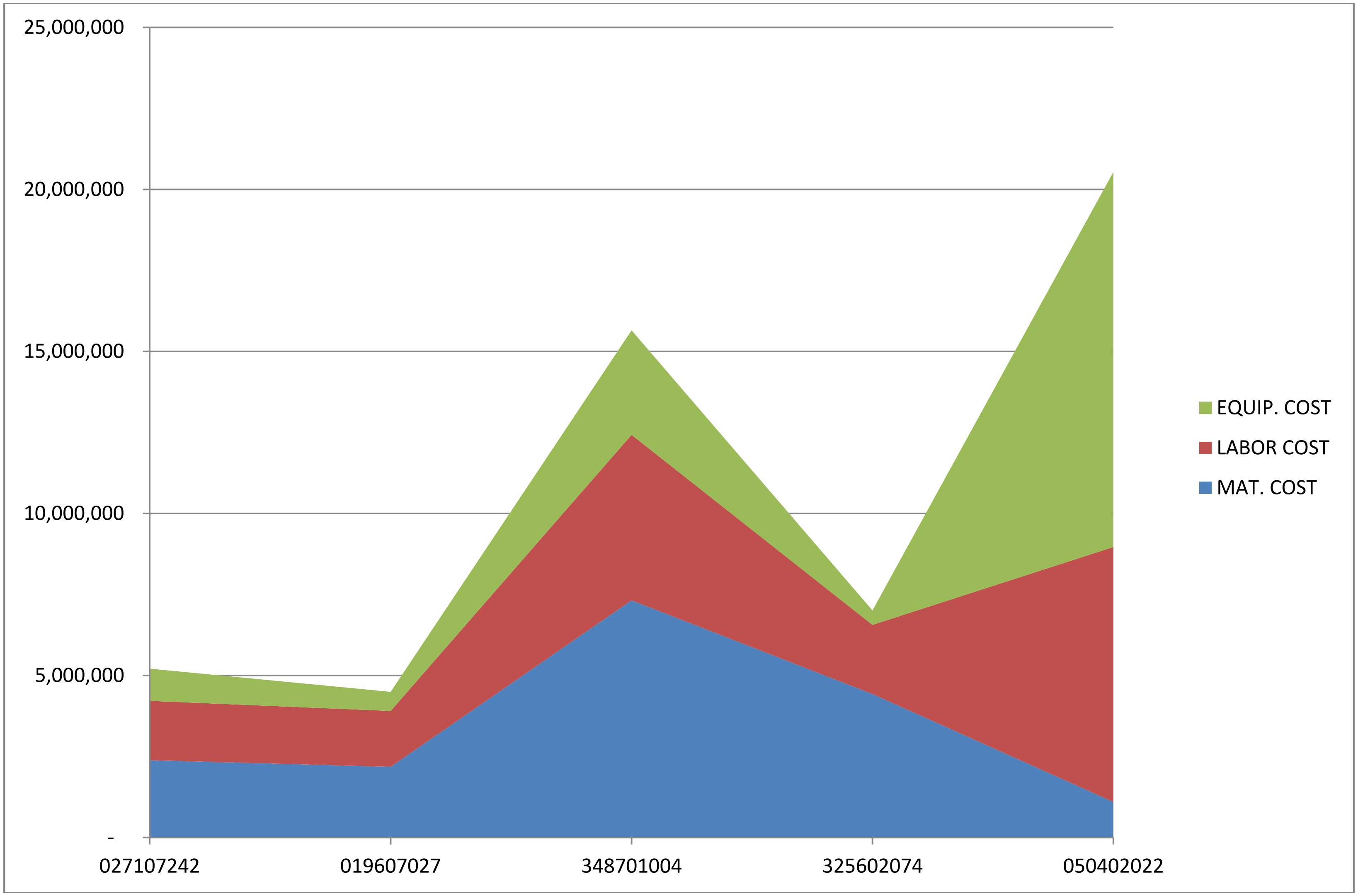


Figure 6.22: Estimated Total ELM Costs

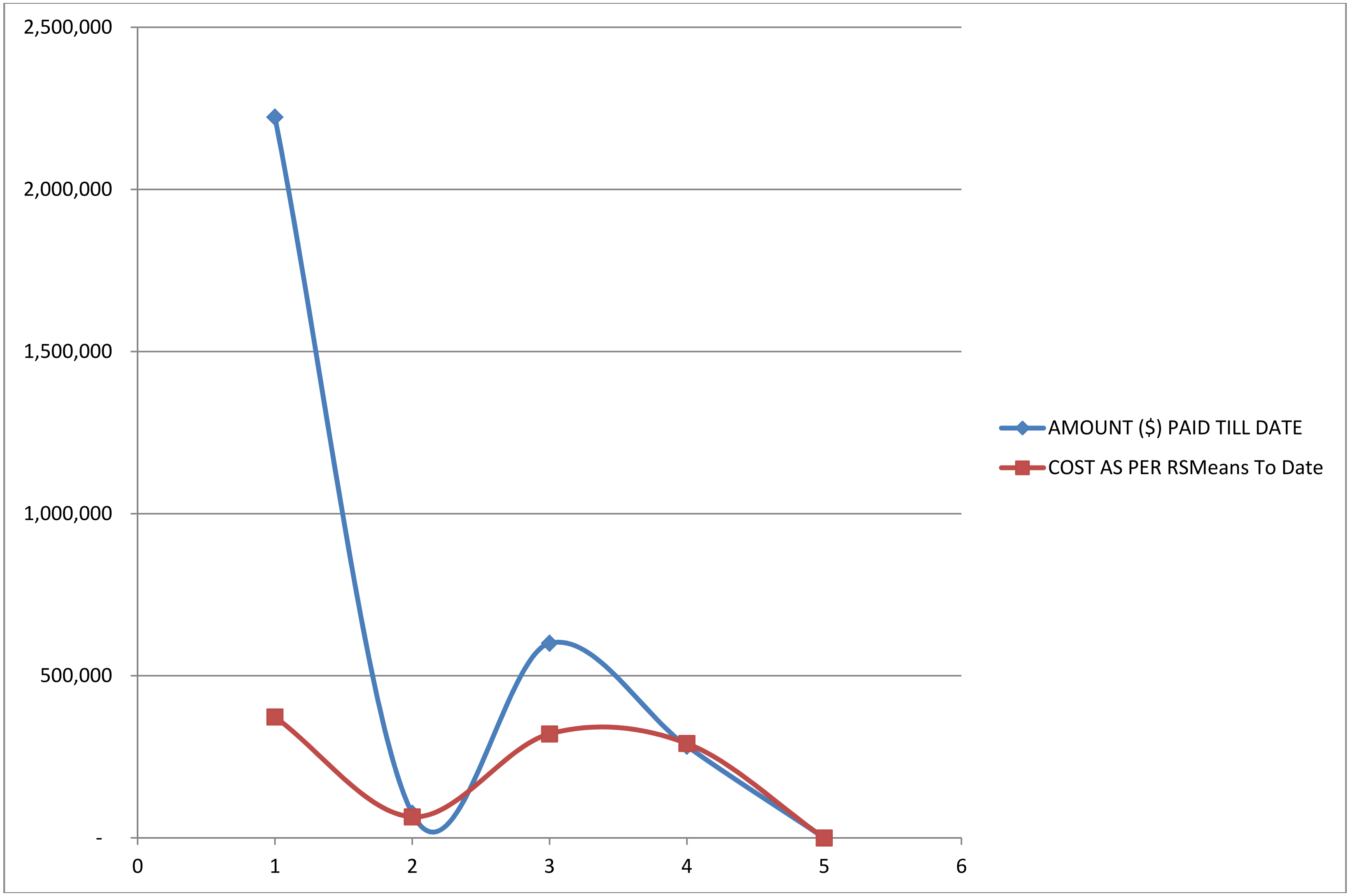


Figure 6.19: Estimated Cost (to date) vs. Amount Paid (to date) for Drainage work

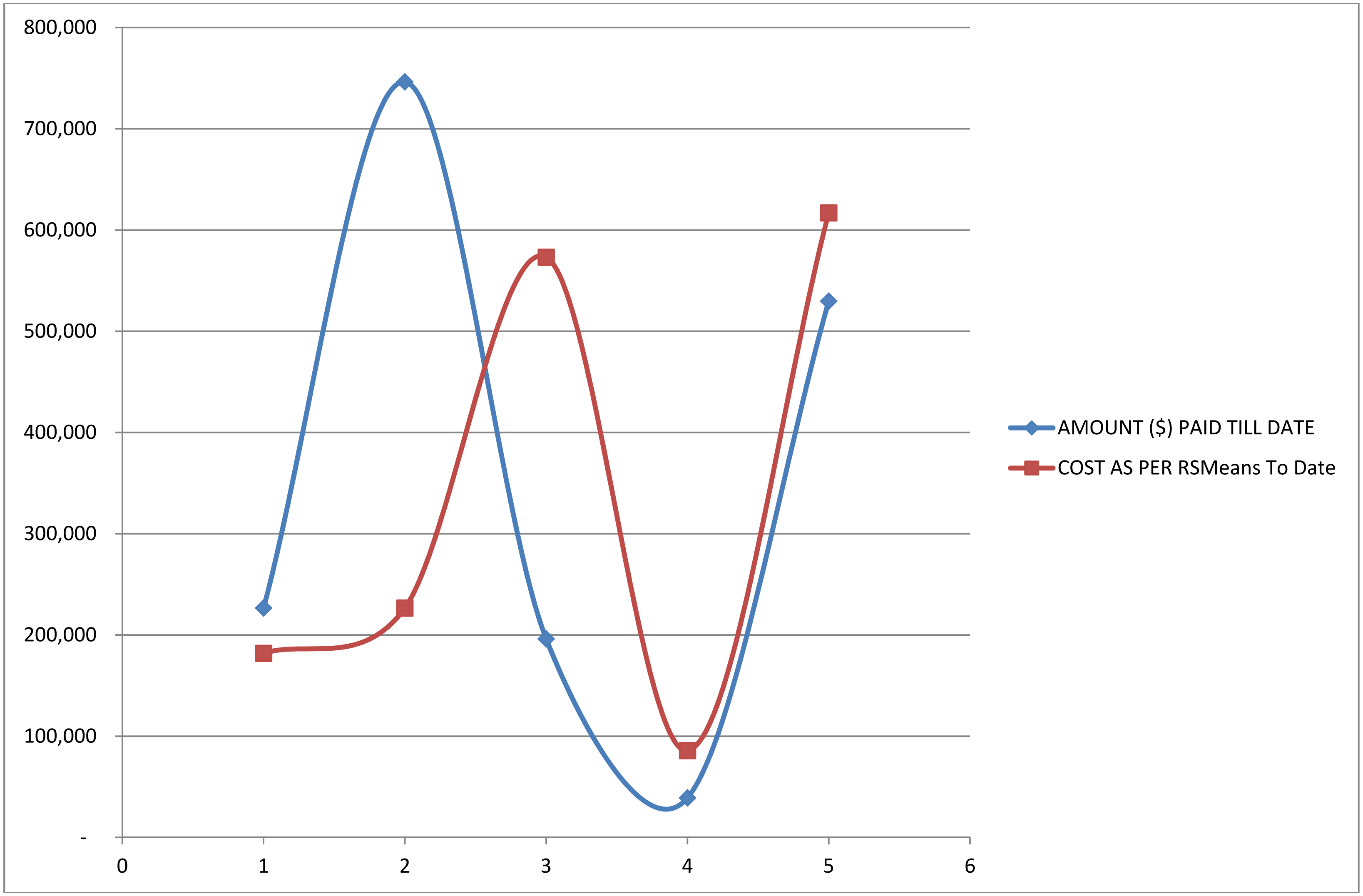


Figure 6.20: Estimated Cost (to date) vs. Amount Paid (to date) for Site Improvement

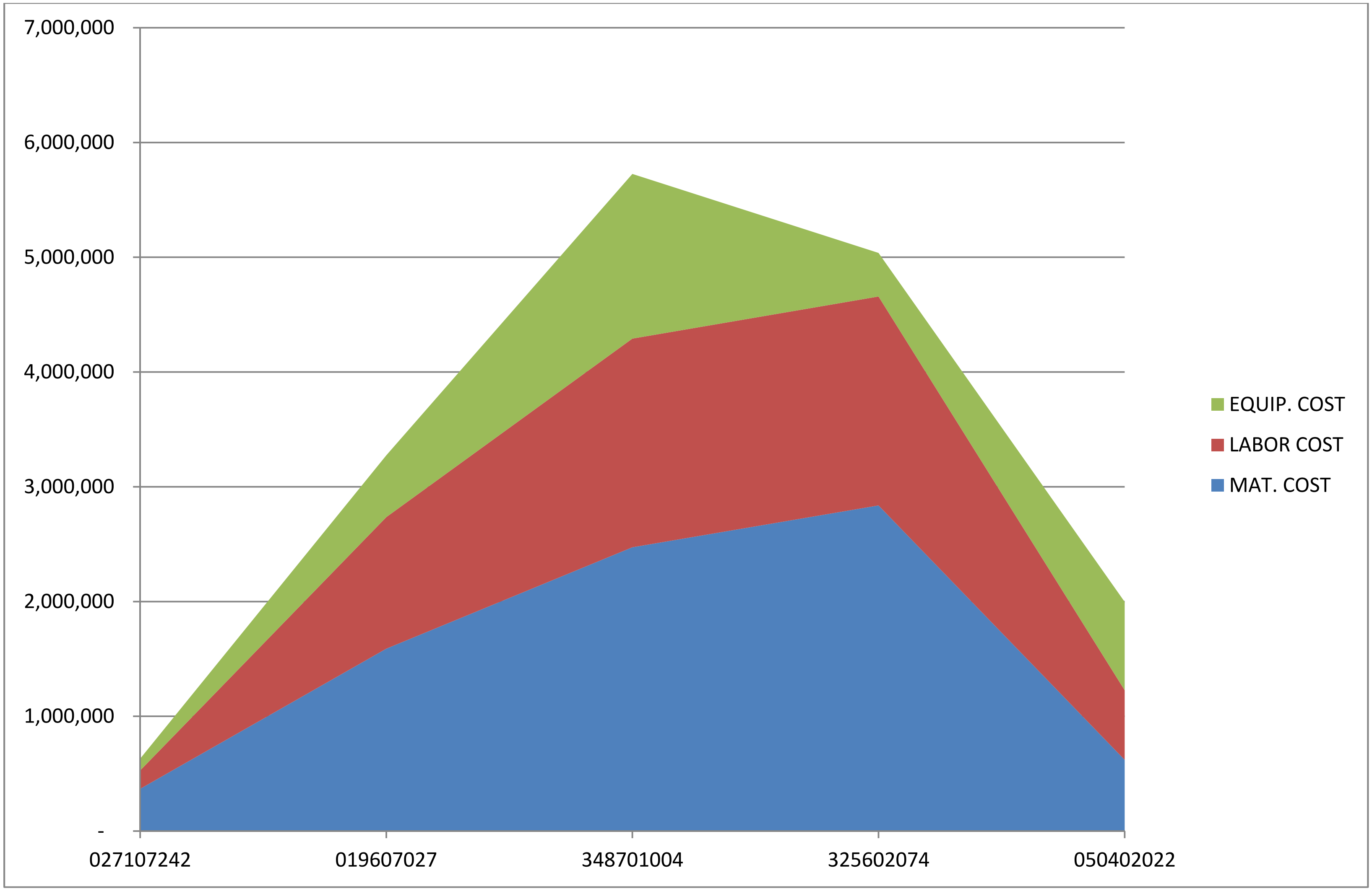


Figure 6.21: Estimated ELM Costs for Quantities executed to date

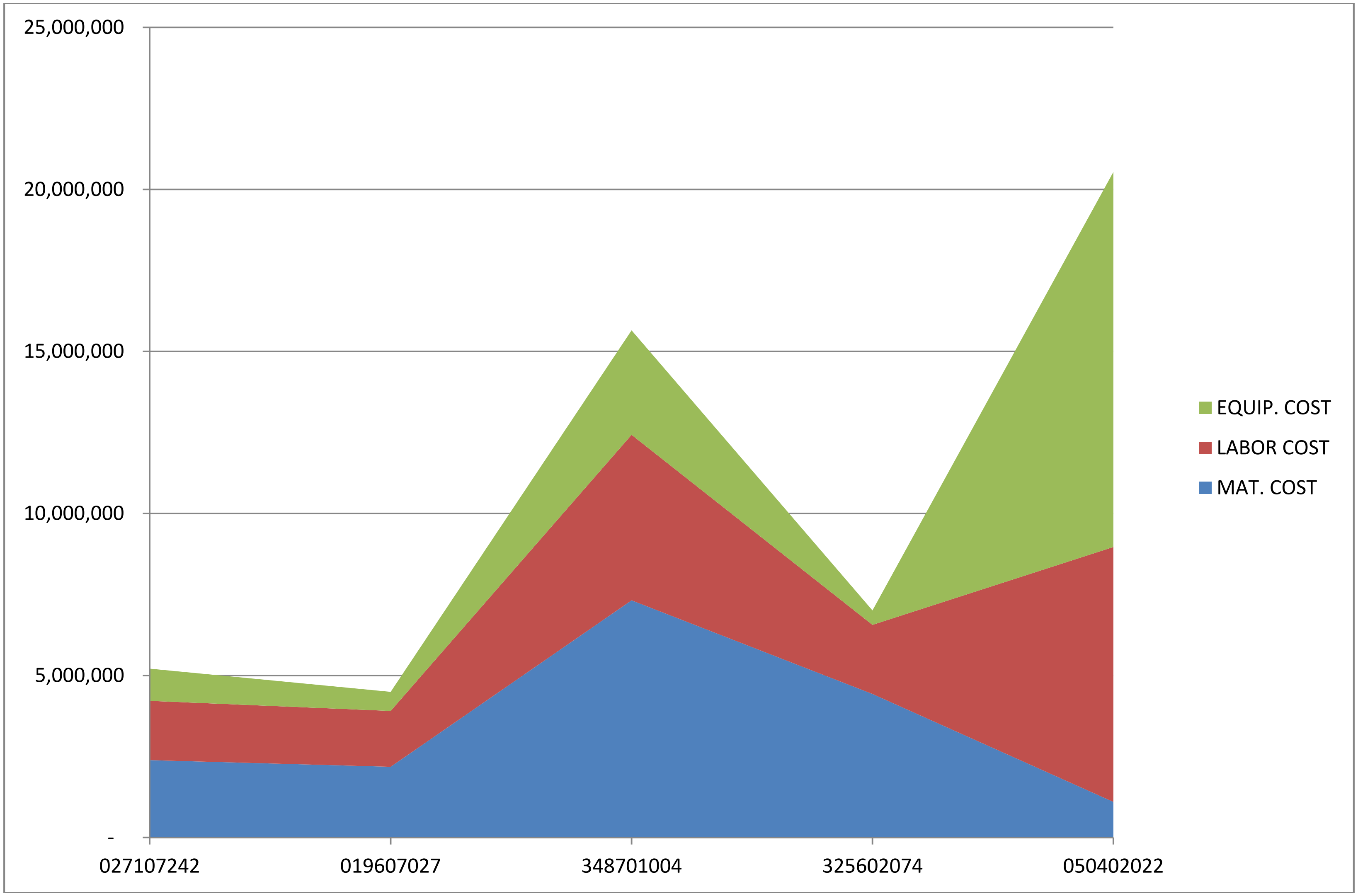


Figure 6.22: Estimated Total ELM Costs

Chapter 7. Conclusions and Recommendations

7.1 Introduction

This study sought to estimate job creation in the construction industry from investments in transportation projects, specifically in the context of the 2008–2009 economic downturn and federal stimulus spending on 'shovel-ready' projects. The results were aimed at supporting or disproving claims that spending on construction creates jobs, an important consideration for transportation policy makers seeking support for additional funding. The results were also aimed at providing insights into what types of construction activities and projects are most labor-intensive, and how the construction industry makes decisions on increasing or reducing its labor force. Direct (on-site) labor usage was evaluated through statistical analyses, and indirect (off-site) labor usage was assessed thorough interviews with contractors and exploration of material and transport supply chains.

7.2 Key Findings

The following are the key findings of this research:

1. The general opinion of contractors is that ARRA funds have saved jobs in many contractor organizations even if they have not created new jobs. ARRA has kept the industry alive and ready to respond when the private sector has enough confidence to start investing again.
2. Government spending is usually 10–20% of contractor activity. But with the disappearance of private spending in the last 2 years, all contractors have had greater reliance on public spending. In that respect Texas has been better than other states, and a number of out-of-state companies have been competing fiercely for TxDOT work, driving down prices.
3. The ARRA funds were spent at the best time: low prices have bought more projects than usual.
4. The companies interviewed are all dependent on TxDOT work, whether or not ARRA. They benefit when TxDOT lettings increase, and voiced support for more funding for TxDOT. Many like TxDOT work because of the predictability of the volume, and the certainty/quality of TxDOT specifications.
5. Contractors feel morally obligated to their employees and families: each job saved supports perhaps three more people (a spouse and two children).
6. Most contractor employees rely on overtime for spending money (which supports jobs in the wider economy), and in a tight economy without overtime, they have not been spending.
7. Suppliers are intimately aware of how their businesses impact their local economy. In one case the supplier knew how may school teachers were being supported by taxes generated by their company.
8. The cost of transport is a significant element of highway projects, and location of material sources and suppliers gives advantage to specific contractors. Given the competitive environment, materials suppliers close to jobsites have benefited from ARRA funds. However, most of them do not know the funding sources of the business they receive.

9. Contractors are maximizing equipment usage. More equipment is being utilized now that the workforce at most of the companies is lean. An indirect benefit here could be that the industries that make products utilized in maintenance and operation of such equipment are being supported. The construction support sector could be considered as one where ARRA funding has had a positive indirect impact.
10. Contractors were asked how they would stimulate the economy and create jobs, and most of them could not suggest anything other than more government spending. They felt that of all government spending, infrastructure is the best because tangible assets are created, they improve economic efficiency, and ultimately create jobs.
11. Direct jobs from ARRA are being accurately tracked, but indirect/induced jobs are very difficult to quantify due to the unique economic circumstance at present. Current commercial models would give misleading answers. Imposing additional reporting requirement on downstream companies would be impossible because most have no idea how most of their work is funded.
12. Due to data limitations and the enormity of interdependence among different industries across different projects, accurate estimation of indirect labor usage is difficult. However, it is clear that indirect benefits definitely accrue to secondary and tertiary industries. Similar opinions were echoed most of by the interviewees, i.e., even if ARRA funds did not create any new visible employment opportunities, it did help save a large number of existing jobs.

7.3 Conclusions

The following are the main conclusions of this research:

1. Each sector of contracting has a different hiring/firing strategy:
    a. Every project creates a demand for work hours. Increase in contracts will increase the demand for work hours. Site contractors flex their employee work hours up and down (ranging 30–70 hours per week). The contractor would start hiring when the work hours of existing employees cannot be stretched beyond about 70 hours per week. Starting from a situation where employees may be working less than 30 hours per week, that is a large flex before new hiring happens. A similar trend is observed but in reverse during periods of low business. The contractors reduce the work hours of employees in response to the shrinking volume of work until they are compelled to lay off people. Thus they are slow to drop or add jobs: they try to keep their people through a downturn by paying fewer hours per week, but do not hire in an upturn and just pay more hours per week. Hence, it can be said that site contractors are lagging indicators of employment.
    b. Material suppliers are direct indicators: they pay on an hourly basis, and so drop or add hours or jobs elastically. Employment in material supply industries appears to be based on the prevailing market conditions and the growth or loss of jobs is reflective of how well the economy is performing and its ability to support the jobs at these plants which is directly dependent on the demand for the materials produced. As the demand and hence the production at these plants decrease, people (beginning with unskilled/minimum wage workers) start getting laid off until just the core group of skilled operators are retained. If the trend continues, the overtime and subsequently work-week hours are cut. A similar phenomenon is observed in inverse when the economy and demand picks up. The

working hours of the trained personnel are extended and number of unskilled/hourly wage workers increases.

c. Material transport companies are leading indicators of employment. They pay by volume and have to have capacity if demand appears or shed capacity as it disappears. Employment is dependent on companies' prediction of future workload. They therefore fire and hire, and sell or buy trucks 'predictively': they lay off workers early in a downturn and hire early as the economy picks up. This means that growth or loss of jobs is dependent on confidence in the economy.

d. It also appears that the compensation structure in a sector may play a role in job creation/loss. Truck drivers are paid either by mile, by gross or by hour. Demand for fewer miles means less/zero pay which is equivalent to being out of work (job loss), while demand for more miles means job creation, because each driver has a limit on driving hours. Owners shrink their labor force by cutting hours until drivers leave, and then sell off the older trucks. This insight also suggests that job growth in the trucking sector is directly correlated with induced labor in the truck manufacturing sector.

2. Contractors hire when they already have work lined up or have confidence that future economic activity will stimulate demand for their services. Based on the fact that they flex employee work hours from 30 to 70 hour per week, <u>new jobs would only be created when work volume more than doubles</u>.
3. Building a project in a particular location does not translate to direct jobs in that area because contractors are utilizing in-house forces as much as possible to save their organizations, while suppliers always utilize labor from around their base.
4. These factors explain why ARRA funding did not seem to 'create' as many construction jobs as expected. However, it is clear that the ARRA funding helped many firms, either directly or indirectly, to retain at least a part of their workforce and enabled them to stay in business. As one contractor put it: "ARRA may not have created jobs, but it saved our industry."

7.4 Recommendations

Based on the above findings and results of this research, the researchers provide the following recommendations:

1. Because direct labor is already being recorded and submitted by contractors, TxDOT should institute a similar system for all projects. This data would be useful for reporting the direct construction labor benefits of TxDOT construction expenditures.
2. Direct labor is just about 30% of project cost, which means that suppliers and equipment companies receive about 70% of project expenditures. That finding suggests that projects with high material usage benefit Texas workers, while projects with high equipment usage benefit out-of-state manufacturers. TxDOT may want to consider this fact if funding is to be tied to supporting the local economy.
3. ARRA funding has supported many jobs in industries such as asphalt, concrete, quarrying, etc. However, there were no jobs 'created' in these industries. Almost all the industries were of the opinion that the funding at present was not enough and that it should be increased. However, from some of the interviews it was clear that the bigger problem is the lack of confidence in the market right now. Therefore, increased and steady funding would give

contractors confidence and support Texas jobs. Such funding will in turn help in restoring the confidence of the private sector to the point where it again starts investing in projects.

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