

Construction Management System (CMS) Feasibility Study Report



Version 1



**State of California
Department of Transportation**



Division of Construction

May 18, 2005

Revised October 7, 2005

Information Technology Project Request

Feasibility Study Report Executive Approval Transmittal



Department Name

Department of Transportation

Project Title (maximum of 75 characters)

Construction Management System

Project Acronym	Department Priority	Agency Priority
CMS	1	1

APPROVAL SIGNATURES

I am submitting the attached Feasibility Study Report (FSR) in support of our request for the Department of Finance's approval to undertake this project.

I certify that the FSR was prepared in accordance with State Administrative Manual Sections 4920-4930.1 and that the proposed project is consistent with our information technology strategy as expressed in our current Agency Information Management Strategy (AIMS).

I have reviewed and agree with the information in the attached Feasibility Study Report.

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Budget Officer		Date Signed
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Agency Secretary		Date Signed
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Section 1.0 - Overview

The California Department of Transportation (Department) is responsible for overseeing the construction of all capital outlay and major maintenance projects undertaken to maintain and improve California's transportation system. Within this structure, the headquarters construction program and district construction divisions work with external contractors to build the highways, bridges, and freeways that the people of California use every day.

Seven districts/regions¹ manage the district/region construction programs, administer construction contracts, conduct inspections to ensure contract compliance and product quality, document issues and work performed, and authorize contractor payments. Studies conducted over the last several years by the Department and external consultants have concluded that involved business functions have begun to develop problems and inefficiencies due to the magnitude and complexity of the construction program.

Since 1968, the Department has supported the contract administration function with one primary system, the Contract Administration System (CAS). This system has served the Department well for a period far longer than could be envisioned when it was first developed. However, a lack of flexibility and capability in old mainframe systems, as well as the increasing pace of legislative change at both the state and federal levels creates a situation where CAS cannot be considered as a viable tool to support the program. As recently as this last fiscal year, two separate changes needed by the program were so costly to implement, and would take over 6 months to complete, that the construction program has had to handle changes outside of the CAS system. While necessary and more cost effective in the short term, the result of this situation is that the Department does not have a single, reliable system with which to manage all construction project activities. Information is in multiple systems, including small desktop databases. In some cases, the most current data is contained in paper files within the districts and are not easily accessible when required by headquarters or district staff. To understand the magnitude of paper involved in managing just one large construction project, one only needs to look at the picture on the title page.

This study considers the degree that fiscal inefficiencies may be present within the program as it relates to the lack of supporting automated solutions. Specific to Contract Management, it is clear that inefficiencies associated with outdated technology, and an outdated system, are creating direct hard-dollar costs to the program. The fiscal impacts are seen through increased cost of contract administration, impacts to the quality of the work performed, and, in many situations, additional financial risk to the program. The sources of these problems come from two general areas:

- 1) Business functions are supported by information systems that are out-of-date and beyond their useful life. As a result, business program functions have grown beyond the capabilities of the current systems, the systems are not able to support the informational needs of the construction program, and there is an increasing risk of system failure.
- 2) Business functions include labor-intensive manual processes based on ever-increasing paper documents and files, causing an increase in the amount of time needed to report required information and a decrease in the amount of time available to conduct tasks and activities that ensure product quality. Due to manual handling, paper-based processes and files are inherently error prone and difficult to access, causing additional program costs.

¹ Three of the twelve districts comprise the North Region, four comprise the Central Region, and the remaining five districts are not grouped.

The construction program developed a strategic plan that addresses these problems, and maps out the future direction of construction information technology. This plan includes evaluating, designing, and developing a Construction Management System (CMS) that will serve the construction business needs of the Department and the contractor community. The study of the business problems and solutions related to CMS was initiated to address the program needs. In concert with the CMS study, the Department has also studied the processes, procedures, and standard infrastructure necessary to support a single, Integrated Financial Management System (IFMS). The findings presented in this study complement and augment those identified within the IFMS, prepare the Department to leverage CMS as an interface to IFMS, and position the construction program with the tools necessary to improve the management of construction projects.

This document presents the findings of the Department's business analysis, the research of best practices in the construction industry, and the possible solutions to identified problems. The result is a recommended solution and approach based upon the lessons learned by other states in implementing similar technologies to improve their programs. The study found that both the lowest cost and lowest risk approach to implementing a business solution follows a path consistent with successful projects from other state transportation agencies. This approach will transfer a base solution from another state, a solution which is already supported by the federal government and proven to work, and then modify it to meet the Department's unique business and technical requirements. In taking this approach, the Department expects to solve core challenges facing the program through the use of new technology, and do so with a conservative, proven approach based upon many of the lessons shared with us by other states.

The proposed project addresses the following major business objectives for CMS:

1. Eliminate the financial impact of Federal-Aid Ineligibility Notifications (FINs).
2. Reduce contract claim payments with increased effectiveness of contract dispute research and documentation during construction and the contract administrative dispute process.
3. Reduce the internal cost of claim and arbitration research.
4. Reduce contract arbitration awards and settlements with increased efficiency of researching and documenting contract disputes, and increased effectiveness of expert witness testimony during arbitration.
5. Eliminate the risk of incurring interest charges due to delayed payments to contractors.

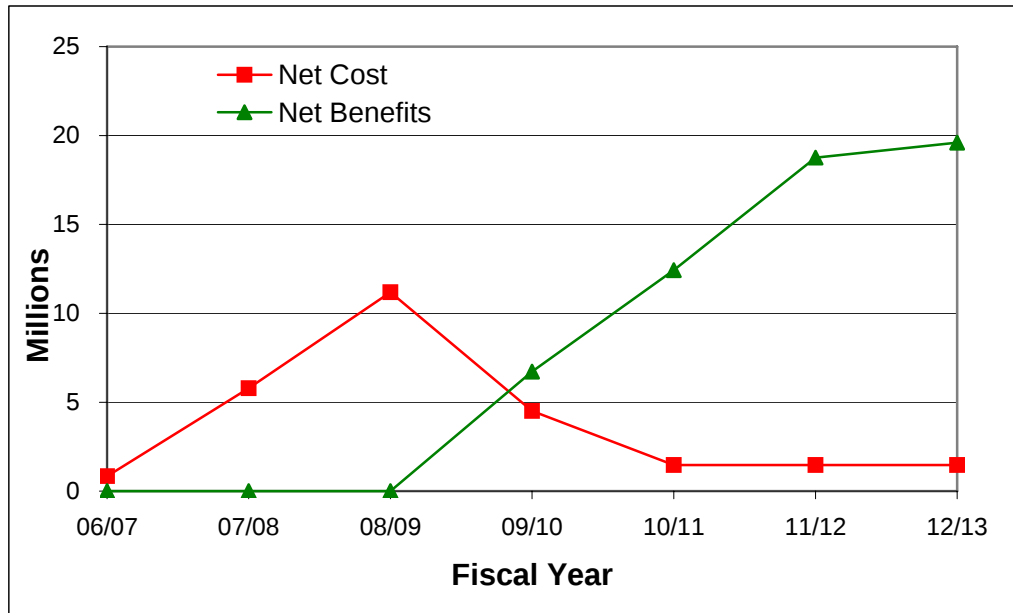
In addition, the program expects to receive the following intangible benefits through the implementation of this project:

6. Implement a business support system that can be modified to accommodate changes in the construction program's business needs faster and at a lesser cost than is now required.
7. Improve access to project information between districts and headquarters.
8. Increase the time the resident engineer (RE) and staff have to focus on the quality of the highways being constructed. (The RE is the construction contract manager.)

The proposed CMS will fully meet these program objectives, providing a hard-dollar breakeven point 18 months following full implementation of the system. The total project costs as planned over a 4 year period are \$20.8 million. Further, the system is expected to produce \$18.8 million in benefits per year, once full benefits are achieved, while only increasing ongoing costs by **\$1.4 million per year**. The projected cost benefit for this project, including one-time and ongoing costs, is depicted in Figure 1-1.

The proposed solution leverages current investments to the extent possible, while also minimizing project risk through the use of the Department's standard technologies.

Figure 1-1 CMS Net Cost Benefit Graph



When considering the CMS system, it is important to note that the Department is also working with the Department of Finance on the proposed Integrated Financial Management System (IFMS). As we move forward with CMS, the Department has defined the scope and structure with constraints that will specifically allow CMS to easily interact with the IFMS at the point it comes into existence. Within the proposed architecture of IFMS, the CMS is expected to be an interfacing system, which provides payment triggers to IFMS. Within the CMS project, all messaging and interfaces will be built upon extensible markup language (XML) standard message layouts consistent with the IFMS proposed standards and the proposed set of XML schema for transportation applications in a framework to be called TransXML. In taking this approach, CMS will have a well-structured industry-standard interface design as described in the IFMS architecture. CMS will be the Department's first venture which recognizes this standard and will enforce it as a technical solution requirement.

INFORMATION TECHNOLOGY PROJECT SUMMARY PACKAGE
SECTION A: EXECUTIVE SUMMARY

Section 2.0 - IT Project Summary Package

1.	Submittal Date	05/01/2005
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		FSR	SPR	PSP Only	Other:
2.	Type of Document	X			
	Project Number				

			Estimated Project Dates	
3.	Project Title	Construction Management System	Start	End
	Project Acronym	CMS	7/1/2006	3/01/2010

4.	Submitting Department	Department of Transportation
5.	Reporting Agency	Business, Transportation and Housing

6.	Project Objectives
	The business objectives are: 1. Eliminate costs due to Federal Aid Ineligibility Notices 2. Reduce Contract Claim payout by 10% 3. Improve cost efficiency in performing claim defense preparation 4. Reduce Arbitration/Settlement payout by 10% 5. Eliminate risk of late payment penalty interest due to system failures 6. Improve the responsiveness of IT in being able to quickly implement new legislation, processes, or rules

8.	Major Milestones	Est. Completion Date
	Approval to Proceed	7/1/2006
	Request for Proposal (RFP) Release	12/1/2006
	Contract Approval	7/15/2007
	Phase 1 Implementation	5/1/2009
	Phase 2 Implementation	3/1/2010
	Post Implementation Evaluation Report (PIER)	6/1/2011
	(please see Sect. 6 for a more complete table)	
	Key Deliverables	
	RFP	12/1/2006
	Project Plan	9/15/2007
	Phase 1 Design	3/15/2008
	Phase 1 Implementation	5/1/2009
	Phase 2 Design	7/15/2009
	Phase 2 Implementation	3/1/2010

7.	Proposed Solution
	The proposed solution includes the transfer and modification of the existing Construction Management application currently used by other state transportation agencies. The system will be modified to meet California's specific business and technical requirements.

INFORMATION TECHNOLOGY PROJECT SUMMARY PACKAGE
SECTION B: PROJECT CONTACTS

Project #	
Doc. Type	

Executive Contacts								
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INFORMATION TECHNOLOGY PROJECT SUMMARY
SECTION C: PROJECT RELEVANCE TO STATE AND/OR DEPARTMENTAL PLANS

1.	What is the date of your current Operational Recovery Plan (ORP)?	Date	10/2003
2.	What is the date of your current Agency Information Management Strategy (AIMS)?	Date	7/2004
3.	For the proposed project, provide the page reference in your current AIMS and/or strategic business plan.	Doc.	
		Page #	

Project #	
Doc. Type	

4.	Is the project reportable to control agencies?	Yes	No
		X	
	If YES, CHECK all that apply:		
	X a) The project involves a budget action.		
	b) A new system development or acquisition that is specifically required by legislative mandate or is subject to special legislative review as specified in budget control language or other legislation.		
	c) The project involves the acquisition of microcomputer commodities and the agency does not have an approved Workgroup Computing Policy.		
	X d) The estimated total development and acquisition cost exceeds the departmental cost threshold.		
	e) The project meets a condition previously imposed by Finance.		

INFORMATION TECHNOLOGY PROJECT SUMMARY PACKAGE
SECTION D: BUDGET INFORMATION

Project #	
Doc. Type	

Budget Augmentation Required?	No											
	Yes	X	If YES, indicate fiscal year(s) and associated amount:									
			FY	06/07	FY	07/08	FY	08/09	FY	09/10	FY	10/11
			\$851,451		\$4,947,989		\$5,395,460		\$-6,787,204		\$-3,049,340	

PROJECT COSTS

1.	Fiscal Year	2006/07	2007/08	2008/09	2009/10	2010/11	TOTAL
2.	One-Time Cost	\$851,451	\$5,799,440	\$10,948,187	\$3,174,340	\$0	\$20,773,418
3.	Continuing Costs			\$246,713	\$1,233,356	\$1,358,356	\$2,838,425
4.	TOTAL PROJECT BUDGET	\$851,451	\$5,799,440	\$11,194,900	\$4,407,696	\$1,358,356	\$23,611,843

SOURCES OF FUNDING

5.	General Fund						\$
6.	Redirection						\$
7.	Reimbursements						\$
8.	Federal Funds						\$
9.	Special Funds						\$
10.	Grant Funds						\$
11.	Other Funds – St Hwy Acct	\$851,451	\$5,799,440	\$11,194,900	\$4,407,696	\$1,358,356	\$23,611,843
12.	PROJECT BUDGET	\$851,451	\$5,799,440	\$11,194,900	\$4,407,696	\$1,358,356	\$23,611,843

PROJECT FINANCIAL BENEFITS

13.	Cost Savings/Avoidances	\$	\$	\$	\$6,730,753	\$12,433,720	\$19,164,473
14.	Revenue Increase	\$	\$	\$	\$	\$	\$

NOTE: Full benefits of \$18,750,049 per annum will be achieved in the 2010/11 fiscal year.

INFORMATION TECHNOLOGY PROJECT SUMMARY PACKAGE
SECTION E: VENDOR PROJECT BUDGET

Vendor Cost for FSR Development (if applicable)	\$ 329,920 / \$61,288
Vendor Name	VIP, Inc. / Coastline Technology Consulting, Inc.

Project #	
Doc. Type	

VENDOR PROJECT BUDGET

1.	Fiscal Year	2006/07	2007/08	2008/09	2009/10	20010/11	TOTAL
2.	Primary Vendor Budget		\$3,396,557	\$7,936,186	\$2,384,122		\$13,716,865
3.	Independent Oversight Budget	\$48,989	\$280,325	\$326,592	\$136,080		\$791,986
4.	IV&V Budget	\$43,546	\$491,098	\$580,608	\$241,902		\$1,357,154
5.	Other Budget	\$556,416	\$334,656	\$340,304	\$120,960		\$1,352,336
6.	TOTAL VENDOR BUDGET	\$648,951	\$4,502,636	\$9,183,690	\$2,883,082		\$17,218,359

------(Applies to SPR only)-----

PRIMARY VENDOR HISTORY SPECIFIC TO THIS PROJECT

7.	Primary Vendor	
8.	Contract Start Date	
9.	Contract End Date (projected)	
10.	Amount	\$

PRIMARY VENDOR CONTACTS

	Vendor	First Name	Last Name	Area Code	Phone #	Ext.	Area Code	Fax #	E-mail
11.									
12.									
13.									

INFORMATION TECHNOLOGY PROJECT SUMMARY PACKAGE
SECTION F: RISK ASSESSMENT INFORMATION

Project #	
Doc. Type	

RISK ASSESSMENT

	Yes	No
Has a Risk Management Plan been developed for this project?	X	

General Comment(s)
Initial risk brainstorming has been performed and to the extent possible, known risks have been addressed within the FSR. Upon approval of the project and hiring of a project manager, development of the formal Risk Management Plan will be a core deliverable of the project manager.

Section 3.0 - Business Case

3.1 Business Program Background

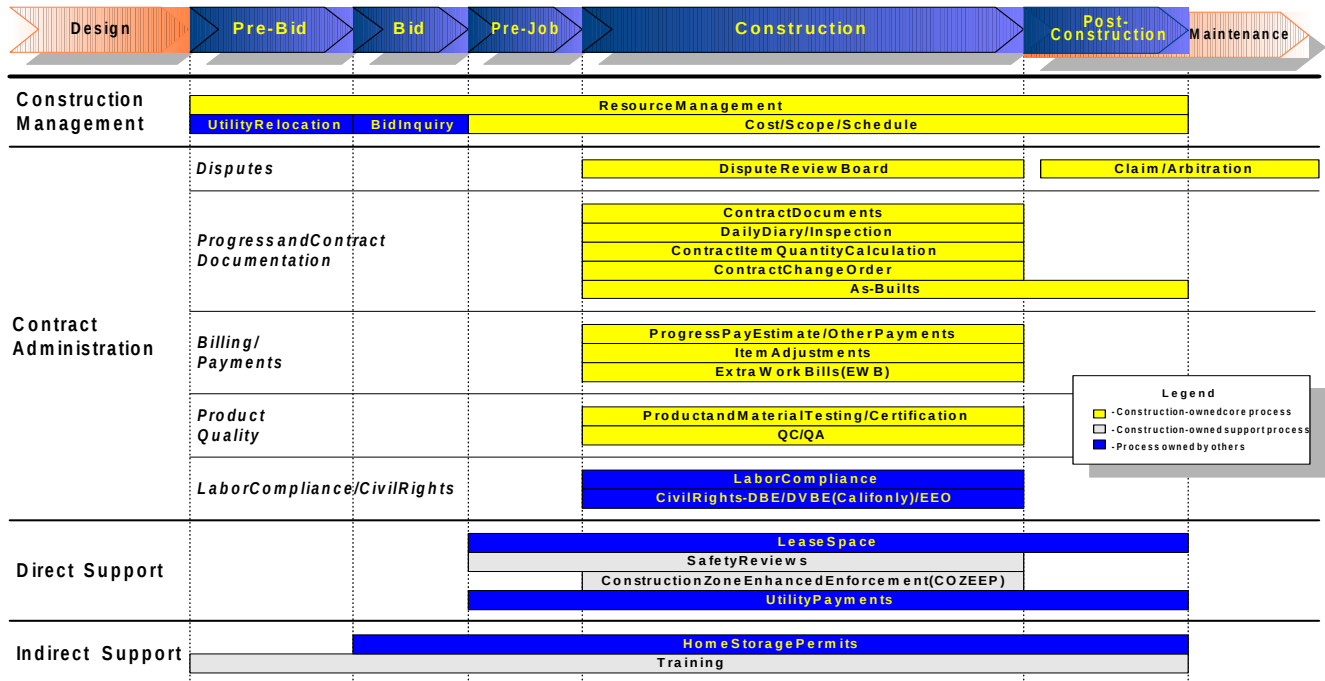
3.1.1 What do the Department construction program and district construction divisions do?

The California Department of Transportation (Department) is the owner and operator of the State highway and freeway system. The Department advertises construction contracts; private contractors bid the work; and the Department awards contracts to the lowest responsible bidder. The Department's district/region construction divisions administer the construction contracts according to the policies and procedures established by the headquarters construction program. The district construction division resident engineer (RE) ensures that the contractor does the work according to the contract plans and specifications, that the quality of the work meets or exceeds quality and good workmanship standards, and that the contractors get paid for the work they perform.

The Department currently administers highway construction contract payments totaling just over \$2.1 billion per year. Contracts under the responsibility of the Department range from projects as small as sealing cracks as minor maintenance on highways to building the new East Span of the San Francisco - Oakland Bay Bridge. During fiscal year 2003/2004, the Department paid contractors \$2.16 billion on over 589 construction contracts. The total value of all contracts under construction at the close of FY 2003/2004 totaled \$7.1 billion.

The construction divisions perform "constructability reviews" during design, answer contractors' questions during the bidding process, and become responsible for the contract administration after the contract is awarded. During the pre-job, construction, and post-construction phases, the RE, assistant resident engineer (ARE), and staff work with the contractors to make sure the project is on schedule, within budget, and built according to the contract requirements. The RE also manages progress and contract documentation, handles disputes with contractors, inspects the work to ensure it is built to quality and workmanship standards, reports on labor compliance and disadvantaged business participation, and determines how much contractors are paid each month for the work they have performed. A visual depiction of the activities performed during the execution of a construction project is included in Figure 3-1 Construction Project Processes.

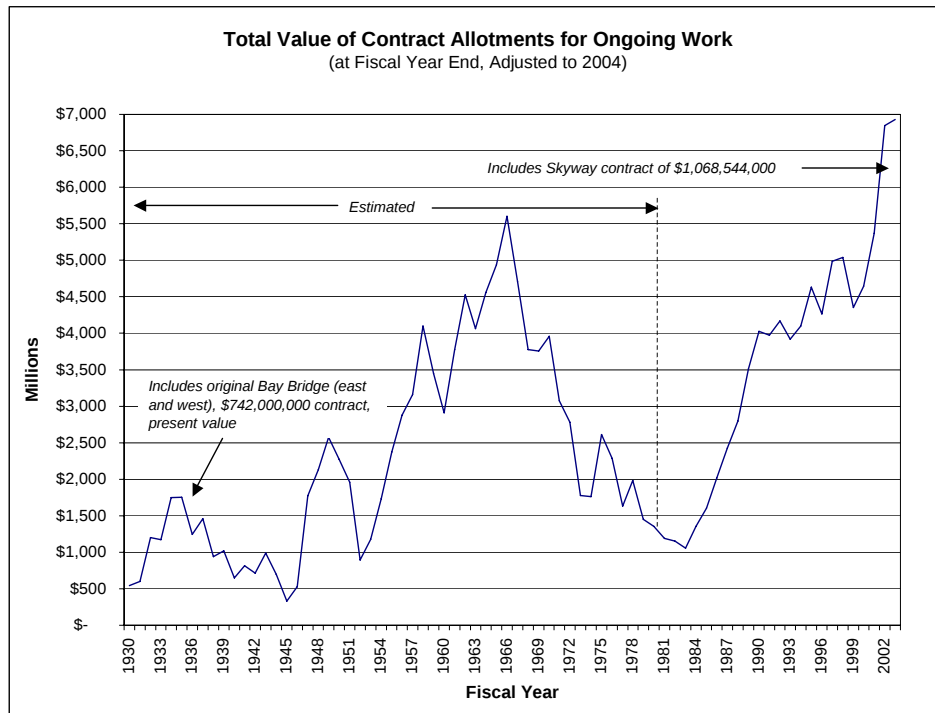
Figure 3-1 Construction Project Processes



3.1.2 History of Construction Program Growth

Analysis of the annual value of construction contracts spanning the past 70 years has shown a significant growth in the total value of contracts for which the construction program is responsible.

Figure 3-2 Historical Contract Allotments



Over the past 20 years, this graph shows that the Department has experienced a period of very heavy growth in the dollar value of construction projects. Within this graph, it should be noted that recent years include the affect of the Toll Bridge Seismic Retrofit projects currently underway. These projects have the impact of increasing the overall dollar value of the contracts being administered; however, this study has treated these projects solely as one-time expenditures rather than as ongoing, yearly expenditures that would permanently increase the dollar value of projects. The following table depicts the impact of these one-time projects on the overall portfolio value under consideration.

Table 3-3 Recent On-Going Construction Contract Totals

<i>Fiscal Year</i>	<i># of Non-Toll Contracts</i>	<i>Value of Non-Toll Contracts</i>	<i># of Toll Contracts</i>	<i>Value of Toll Contracts</i>	<i>Total Value</i>
1998/99	760	\$3.9 B	14	\$0.5 B	\$4.4 B
1999/00	730	\$3.6 B	15	\$0.9 B	\$4.5 B
2000/01	765	\$4.0 B	17	\$1.7 B	\$5.7 B
2001/02	683	\$4.1 B	18	\$3.4 B	\$7.5 B
2002/03	638	\$3.8 B	15	\$3.3 B	\$7.1 B
2003/04	574	\$3.7 B	15	\$3.4 B	\$7.1 B

Based upon the value of these projects, close to 50% of the dollar value of construction projects is currently dedicated to Toll Bridge Seismic Retrofit projects. For the purposes of this study, the effects of the Toll Bridge Seismic Retrofit projects are eliminated from the financial analysis of the ongoing dollar value of construction contracts. In doing this, the Department is able to project future values of benefits, without skewing the analysis due to the large size of the current one-time Toll Bridge Seismic Retrofit projects. Despite this consideration, the Department contract value has increased in value from \$853 million in 1965 to \$3.7 billion in 2004, an average annual increase of 5.5%.

3.1.3 What are the construction program's business processes?

While the construction program is involved in a wide range of activities during the life of a highway construction project, the business functions that are of the highest priority to the construction program, but also at the greatest risk of failure, fall within three areas. These areas are progress and contract documentation, billing/payments, and project closeout.

The progress and contract documentation business functions include:

- **Start-Up Tasks.** These are the activities performed at the beginning of each construction project; such as setting up project office facilities and communication, relocating staff, compiling design documents, taking pictures and documenting the original job site, ensuring utilities are moved from the job site, and meeting with the contractors to review the design, develop schedules and resolve issues.
- **Contract Inquiry/Updates.** During the bidding process, contractors submit questions or requests for clarification to district/region construction divisions. Responses are posted on the Internet notifying all bidders of the question and answer. Depending on the situation, some questions result in a contract addendum prior to contract award.
- **Contractor Information Input.** The contractors are required to fill out dozens of Department forms regarding project and contract activity. The information provided on these forms includes, in part, payroll data, amounts of material on hand, and notices of potential claim.
- **Daily Diary/Inspection Input/Update.** These are the tasks that the RE, ARE, or inspection staff performs primarily at the construction job site. They record project progress, note issues and concerns, record how much labor, equipment, and materials are used, and inspect the work to ensure the project is built to expected quality standards.
- **Contract Item Quantity Calculation.** This is the function the RE or field office staff performs to determine how many people, how much equipment, and how much construction material was used each day on a construction project, and how much the contract allows the contractor to be paid for those items in the monthly pay estimate.
- **Contract Change Order (CCO).** Construction projects often encounter unforeseen problems that create additional work or require additional equipment or materials of the contractor. The CCO function is the process that handles changes to the contract due to increases or decreases in project size, scope, or cost.
- **Reporting.** A large part of the construction program's responsibility is providing information on highway construction projects and contracts. This function includes the processes used to generate reports to the Legislature, the California Transportation Commission, the Department, local funding partners, agency and regional planning organizations.
- **Monthly Labor Compliance, Disadvantaged Business Enterprise, and Civil Rights Reporting.** This is a function that is intended to report on how our contractors are complying with state and federal laws and guidelines regarding labor compliance, disadvantaged business enterprises, and civil rights. This function was historically reported upon contact

completion. However, new federal regulations now require monthly reporting, but the Department has not been able to provide this information from the current legacy system.

The Billing/Payment business functions include:

- **Monthly Progress Pay Estimate.** This is the process for paying each construction contractor each month for the labor, equipment, and materials used on the project as contracted. This process generates payment tapes that are sent to the State Controllers Office to create checks or electronic fund transfers that are sent to contractors. Prior to payment, and depending on progress, the Department's Division of Accounting directs a certain percentage to retention escrow accounts for those contractors that established one.
- **Other Payment Estimate Processes.** These processes handle payments to contractors that occur after the contracts have been accepted, such as for unpaid extra work not previously billed, claims settlements or arbitration awards.
- **Accounting Interface.** This process results in monies being withheld from monthly progress payments for administrative deductions, labor compliance violations, subcontractor stop notices, and others as specified in the contract.

The Project Closeout business functions include:

- **Project Closeout.** This process provides for shutdown of the project site, resolution of all outstanding issues, completion of all project files (including archive), and creation of the Final Project Report.
- **Claims Resolution.** These processes provide for submission of contractor payment disputes, including a structured process for documenting and resolving each claim within a specified timeframe. These processes also provide for elevation of issues if acceptable resolution for both parties is not reached.
- **As-Built.** The RE reviews and updates contract information during the life of the project. For example, most designs need to be adjusted to fit field conditions. These adjustments need to be documented by modifying the original plans to produce a set of "as-built" plans during the life of the project, and final as-built plans filed as permanent documentation.

The Post-Project Audit business functions are non-departmental functions executed by funding partners/organizations external to the Department to ensure the proper expenditure and documentation of project records.

3.1.4 What are the problems and issues that confront the construction program?

As described earlier in this section, the dollar value of construction contracts has increased significantly over the past 40 years. In the past 20 years, this increase has been more significant as the value of projects has increased from just under \$1 billion in 1985 to over \$7 billion in 2004 (see Figure 3-2). However, the dollar value does not describe the problems faced by the Department. It is an indicator of the dramatically increased workload within the Department, and the necessary efficiencies of scale required to effectively manage a program experiencing 700% growth in just less than 20 years.

In addition to the increased program size, the last decade has also seen additional challenges. New state and federal laws and regulations, an increase in the complexity and required documentation of construction projects, an increase in claims and arbitration activity on construction projects, and increasing demands for project and contract information have increased the workload demand on the RE and have required changes in the way the construction program manages its business. Yet, despite these changes and increased workload, the Department has continued to manage construction contracts with



one core system for contract administration which was designed in 1968 and implemented in the early 1970's, the Contract Administration System (CAS).

Starting in the mid-1990's the construction program initiated several business process reviews (BPRs) to analyze all of the functions, processes, and procedures currently used in the construction program, and to identify the significant problems and opportunities that confront the organization. The BPRs found a wide number and variety of problems facing the construction program, but the most significant problems generally fall into one of two categories:

- 1) Business functions are supported by information systems that require more and more maintenance, are not able to support the informational needs of the construction program, or;
- 2) Business functions are supported by ever-increasing manual processes that are paper-based, resulting in multiple filing systems, which contain only a portion of the records necessary to administer a contract. The result of these are labor-intensive manual processes which increase the time spent on administrative tasks, and decrease the time available to conduct activities that improve the quality of work. In addition, the inaccessibility of paper-based documentation significantly hinders research and analysis of construction project and contract information.

The primary source of data for administering these multi-million construction projects is the inspector's daily diary, currently a manual record of the construction details as observed in the field. The daily diary records and quantity calculations form the basis for contractor payments. The data is input into the CAS from Contract Transactions Input (CTI) forms. A vast quantity of important contractual and financial information is reflected in the daily diary.

Manual daily diary records, such as the sample below, contain a wealth of information critical to the effective administration of the contract. The ARE and inspectors complete this form daily, and submit them on a weekly basis for RE approval.

Figure 3-4 Manual Daily Diary Record

Location and description

Project
identification
Stamp

Equipment
and labor data

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
Form 32-100 (Rev. 7/75)

Job # 369604
03-SAC-50-25.3727.3
03-369604 ACP21-0811(001)E
ACRHI-PO50(101)B/HP21L-5288(007)E
In Sac Co near Folsom from 0.1
km w/o Hazel Ave OC to 0.1 km w/o
Hazel Ave OC

Report No. ITEM 13
Date 7-27-80
Shift Hours Start 0720 Stop 1530
Weather Cloudy
CL 7 ALLEGATE ONE REPORT

ASSISTANT RESIDENT ENGINEER'S DAILY

Location & Description of Operation: CONTRACT: GRANITE CONSTRUCTION CO.
① CONTINUING MAKING A.B. GRADE IN MEDIAN BETWEEN HAZEL AVE TO
NATOMA A.H. - SCALE SHEETS & SIGN OUT SHEET ATTACHED -
ON A.B. Haul today WITH 2 TRUCKS - START @ 0730 - END 1430 Hrs - 13
LODS today TOTAL TONNES = (302.35)
② CHECKING FINISHED A.B. GRADE
THROUGHOUT MEDIAN AREA. MET

HOURS - ITEM NO.

EQUIPMENT AND/OR LABOR:

EQPT. NO.	NO. MEN	DESCRIPTION (Of Equipment or Labor)	ITEM 55	ITEM 56	ITEM 57	ITEM 58	ITEM 59	ITEM 60	ITEM 61	ITEM 62	ITEM 63	ITEM 64	ITEM 65	ITEM 66	ITEM 67	ITEM 68	ITEM 69	ITEM 70	ITEM 71	ITEM 72	ITEM 73	ITEM 74	ITEM 75	ITEM 76	ITEM 77	ITEM 78	ITEM 79	ITEM 80	ITEM 81	ITEM 82	ITEM 83	ITEM 84	ITEM 85	ITEM 86	ITEM 87	ITEM 88	ITEM 89	ITEM 90	ITEM 91	ITEM 92	ITEM 93	ITEM 94	ITEM 95	ITEM 96	ITEM 97	ITEM 98	ITEM 99	ITEM 100	ITEM 101	ITEM 102	ITEM 103	ITEM 104	ITEM 105	ITEM 106	ITEM 107	ITEM 108	ITEM 109	ITEM 110	ITEM 111	ITEM 112	ITEM 113	ITEM 114	ITEM 115	ITEM 116	ITEM 117	ITEM 118	ITEM 119	ITEM 120	ITEM 121	ITEM 122	ITEM 123	ITEM 124	ITEM 125	ITEM 126	ITEM 127	ITEM 128	ITEM 129	ITEM 130	ITEM 131	ITEM 132	ITEM 133	ITEM 134	ITEM 135	ITEM 136	ITEM 137	ITEM 138	ITEM 139	ITEM 140	ITEM 141	ITEM 142	ITEM 143	ITEM 144	ITEM 145	ITEM 146	ITEM 147	ITEM 148	ITEM 149	ITEM 150	ITEM 151	ITEM 152	ITEM 153	ITEM 154	ITEM 155	ITEM 156	ITEM 157	ITEM 158	ITEM 159	ITEM 160	ITEM 161	ITEM 162	ITEM 163	ITEM 164	ITEM 165	ITEM 166	ITEM 167	ITEM 168	ITEM 169	ITEM 170	ITEM 171	ITEM 172	ITEM 173	ITEM 174	ITEM 175	ITEM 176	ITEM 177	ITEM 178	ITEM 179	ITEM 180	ITEM 181	ITEM 182	ITEM 183	ITEM 184	ITEM 185	ITEM 186	ITEM 187	ITEM 188	ITEM 189	ITEM 190	ITEM 191	ITEM 192	ITEM 193	ITEM 194	ITEM 195	ITEM 196	ITEM 197	ITEM 198	ITEM 199	ITEM 200	ITEM 201	ITEM 202	ITEM 203	ITEM 204	ITEM 205	ITEM 206	ITEM 207	ITEM 208	ITEM 209	ITEM 210	ITEM 211	ITEM 212	ITEM 213	ITEM 214	ITEM 215	ITEM 216	ITEM 217	ITEM 218	ITEM 219	ITEM 220	ITEM 221	ITEM 222	ITEM 223	ITEM 224	ITEM 225	ITEM 226	ITEM 227	ITEM 228	ITEM 229	ITEM 230	ITEM 231	ITEM 232	ITEM 233	ITEM 234	ITEM 235	ITEM 236	ITEM 237	ITEM 238	ITEM 239	ITEM 240	ITEM 241	ITEM 242	ITEM 243	ITEM 244	ITEM 245	ITEM 246	ITEM 247	ITEM 248	ITEM 249	ITEM 250	ITEM 251	ITEM 252	ITEM 253	ITEM 254	ITEM 255	ITEM 256	ITEM 257	ITEM 258	ITEM 259	ITEM 260	ITEM 261	ITEM 262	ITEM 263	ITEM 264	ITEM 265	ITEM 266	ITEM 267	ITEM 268	ITEM 269	ITEM 270	ITEM 271	ITEM 272	ITEM 273	ITEM 274	ITEM 275	ITEM 276	ITEM 277	ITEM 278	ITEM 279	ITEM 280	ITEM 281	ITEM 282	ITEM 283	ITEM 284	ITEM 285	ITEM 286	ITEM 287	ITEM 288	ITEM 289	ITEM 290	ITEM 291	ITEM 292	ITEM 293	ITEM 294	ITEM 295	ITEM 296	ITEM 297	ITEM 298	ITEM 299	ITEM 300	ITEM 301	ITEM 302	ITEM 303	ITEM 304	ITEM 305	ITEM 306	ITEM 307	ITEM 308	ITEM 309	ITEM 310	ITEM 311	ITEM 312	ITEM 313	ITEM 314	ITEM 315	ITEM 316	ITEM 317	ITEM 318	ITEM 319	ITEM 320	ITEM 321	ITEM 322	ITEM 323	ITEM 324	ITEM 325	ITEM 326	ITEM 327	ITEM 328	ITEM 329	ITEM 330	ITEM 331	ITEM 332	ITEM 333	ITEM 334	ITEM 335	ITEM 336	ITEM 337	ITEM 338	ITEM 339	ITEM 340	ITEM 341	ITEM 342	ITEM 343	ITEM 344	ITEM 345	ITEM 346	ITEM 347	ITEM 348	ITEM 349	ITEM 350	ITEM 351	ITEM 352	ITEM 353	ITEM 354	ITEM 355	ITEM 356	ITEM 357	ITEM 358	ITEM 359	ITEM 360	ITEM 361	ITEM 362	ITEM 363	ITEM 364	ITEM 365	ITEM 366	ITEM 367	ITEM
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With several ARE and inspectors assigned to various locations and activities on a project the compiled daily diary records quickly fill many notebooks. The following photos are pictures of the file room associated with the Richmond-San Rafael Bridge Project. After 18 months this project has compiled over 20 four-shelf bookcases full of project notebooks. These notebooks contain the information needed to resolve contract claims. These pictures are typical of the paper filing and storage associated with larger construction projects and clearly depict the magnitude of paper the construction program is responsible for managing.

Figure 3-5 Richmond – San Rafael Paper Files



Typical construction projects establish a contingency and supplemental work fund ranging from 15 to 20 percent of the total contract cost. These funds are established to accommodate contract changes required by known extra work and unknown work resulting from unanticipated job site conditions. When the RE and the contractor agree regarding extra work situations and the associated compensation, there is generally very little difficulty. The required contract change orders are prepared, processed, and approved as part of normal business. However, when disagreements between the RE and the contractor arise and the differences cannot be resolved to the satisfaction of both parties, the contractor has the right to file a claim for additional compensation.

When contract claims arise, the compiled daily diary records are the source of information the Department uses to analyze the claim. Reading through the manual diaries for claims research consumes an average of 80 hours per claim, and still often results in an inadequate defense against excessive contractor claims.

In addition to the issues related to manual record keeping, additional concerns exist related to the automated systems supporting the construction process:

- It is not cost effective or timely to modify CAS for certain legislative or business process changes.
- CAS is unable to track contract expenditures on a project to date basis resulting in overpayments and contract overruns.
- CAS is unable to track subcontractors, allowing missed payments to subcontractors - a violation for federally funded projects - resulting in lawsuits.

- CAS is unable to view or track all project expenditures.
- Manual calculations made by the RE, which are subject to variation in method and accuracy, lead to contract disputes.
- The RE spends time doing manual accounting work thus impacting their time for contract management of construction projects.
- To research records and files, paper records must be copied and transferred between the district and headquarters.
- CAS payments are not tied to inspection; therefore, some payments are made prior to actual inspections (particularly on materials).
- A reliable, uniform system of construction contract record keeping is not possible in the current method of operation. CAS is unable to relate the work completed to the funding sources for that work.

3.2, 3.3, 3.4 Business Problems, Objectives, Requirements

The total annual cost of the business problems described in this section is estimated to be **\$18.8**. For the purposes of this section, the business problems and objectives are directly related to the business needs/requirements within this section, rather than separating them into separate FSR sections. In this manner, the parameters for consideration of potential solutions are directly linked to the fiscal benefits expected to be achieved as a result of any proposed solution. In addition, all benefits are stated at the amounts to be realized one year after full implementation of the proposed solution.

Problem 1: Audits of project records and approvals by the Federal Highway Administration result in Federal-Aid Ineligibility Notices (FINs) against construction projects that cost an average of \$426,741 per month.

This problem occurs during routine Federal Highway Administration (FHWA) audits of the records of federally funded projects. During the course of a post-project audit, FHWA reviews the paper records to ensure compliance with federal regulations. Typical audit topics could include items such as adequate backup documentation to substantiate payments to the contractor, timely submission of contract change orders (CCOs) to FHWA, or approval of funding by FHWA prior to work being conducted at the project site. Should the FHWA find any irregularities or specific missing documents, a notice is then issued to the Department providing notification of potential federal aid that must be repaid to the federal government. When this occurs, the repayment is a direct dollar-for-dollar reduction in current year federal aid received for activities that had been funded in previous fiscal years.

As a portion of standard business practice, FINs are tracked and managed by Department staff. To assess the business impact of the FINs, this study evaluated each notice received by the Department over the 18 months from January 2003 to June 2004 (the most recent period available at the start of this study). The FINs cited for this benefit calculation represent the actual average cost of FINs to the Department over the 18 month period from January 2003 to June 2004. The only FINs included are those which resulted in determinations against the Department and do not include those the Department was able to successfully defend.

The primary cause of ineligibility is inadequate or untimely documentation for CCOs. In these circumstances, the RE is faced with a daily decision with regard to the project. If the RE suspends work waiting for approval, the Department may be liable for larger change order costs due to Department caused project delays. If the RE allows the contractor to proceed with work, the Department risks loss of federal funds during future audits. This source was responsible for each FIN during the sample period, which suggests that a 100% benefit could be expected should the problem be completely solved through any proposed solution. For the purposes of this expected benefit, the Department conservatively estimates 90% of the total FIN value to allow for the possibility that a system would not completely eliminate all possible sources for FINs.

Objective	Functional Requirement
Business Objective I Eliminate costs incurred as a result of Federal-Aid Ineligibility Notices.	Functional Requirement I-1 The proposed system must provide central collection and a central repository for project construction records, including internal Caltrans data (i.e. CAS), web forms, electronically submitted contractor records, and Caltrans created documents.
	Functional Requirement I-2 The proposed system must provide an interface allowing external funding partners to provide review and approval of project documents and funding.
	Functional Requirement I-3 The proposed system must provide an auditable history of all project reviews and approvals.

Problem 2: Not having contract and project data consistently structured and easily retrievable for contract claim analysis results in an estimated additional cost of \$6.69 million annually in claim payments.

During the life of the contract, contractors submit notices of potential claim if they believe they have a right to additional compensation due to work performed on a construction project. In some cases, the contractor may make the claim due to their belief that the RE is requiring work not included in the contract. In other instances, the contractor may believe they have found a strategic opportunity for additional compensation and can successfully inflate their claim due to inadequate files within the Department.

When a notice of potential claim is received, the RE and district staff must research the specific claim and provide a written response to the notice. This involves reviewing the project and contract documentation to determine if the contractor's claim has merit, and if it does, determine appropriate financial impacts. Because almost all construction program information is located on paper documents the effort to retrieve information is labor intensive, and requires a significant amount of time. If the RE had the opportunity to clearly and quickly analyze data and information relative to the claim, contractors would most likely submit only claims that have a higher probability of success.

As a portion of this study, a review of claims files considered the cause of claims that the Department paid out and could be linked directly to either delays in the processing of claims research by the RE,

missed deadlines, lost paper files, or inadequate documentation of the vendor's actions at the project site. The sampling considered only closed claims in the prior year and yielded an estimate of approximately 10% of the claim dollars directly linked to the business problems under consideration. This particular area is of great concern to the Department as there has been a significant increase in claim activity experienced in the past several years. If this rate of increase continues, it is expected that the increasing claim volume will only compound this problem in future years.

Objective	Functional Requirement
Business Objective II Reduce payout rate of construction claims by 10%.	Functional Requirement II-1 Provide structured business rules and documentation structure to enforce required documentation and timeframes.
	Functional Requirement II-2 Provide the RE with capability to capture, and then transmit, contract records to a central repository while at a project site (to eliminate filing and transcription errors).

Problem 3: The lack of a single repository of contract and claims information results in additional claims research, storage and transcription costs of \$524,586 per year.

Problem 2 studied the financial cost associated with the monies paid out to contractors during the Department's defense of contractor claims. However, the prior problem did not study internal cost impacts and workload associated with researching, preparing for, and defending the Department against contractor claims. As stated in Section 3.1.4, the paper files associated with a project can be voluminous and require a significant research and transcription time. Because almost all construction program information is located on paper documents the effort is labor intensive, and requires a significant amount of time. In many cases, additional cost is incurred when temporary staff is hired to perform administrative file research, document transcription, copying, and filing of paperwork associated with responding to and defending against claims.

Since the cost of this problem is not tracked as an individual cost within the current project accounting, the Department leveraged previous pilot projects conducted within the Toll Bridge Program in District 4. Within this program, several projects were conducted using the existing paper-based process. Several projects were also conducted as a pilot project using a handheld daily dairy PDA to collect, store, and track daily diary information in an automated solution. Following the pilot projects, a cost comparison was conducted between projects of similar magnitude and scope to compare the resulting cost of claims defense. The Carquinez and San Mateo Seismic Retrofit projects were sampled and compared for the sample estimate. The sample calculation is included in Appendix B.

This benefit is expressed as a percentage of cost associated with claims defense versus the total amount of dollars claimed on the project. The pilot project result yields a measure of cost savings of 0.784% of the total amount of contractor claims on the project. This estimate is then applied to the average of total claims the Department receives across all projects to calculate the internal cost efficiency benefit to be expected by a solution.

Objective	Functional Requirement
Business Objective III Reduce claims research costs by 1% of total contractor claims filed per year.	Functional Requirement III-1 Provide a single repository to store and retrieve contract and claims documentation.
	Functional Requirement III-2 Provide a structured data warehouse/mining capability to research project records.

Problem 4: Not having contract and project data and information easily retrievable for arbitration suit defense results in an estimated additional cost of \$3,236,455 per year in awards and settlements.

Once a contractor has proceeded through the claim process, statute allows the contractor to continue to pursue legal action. Generally, contractors file for arbitration when they believe that the Department did not fairly compensate them. The case goes to arbitration and the Legal Division begins defending the interests of the State. The Legal Division initiates research and analyzes the documentation and data related to the project or contract. Because a large amount of this information is stored in paper documents, the same business problems exist that create difficulty for the RE when researching claims.

Arbitration settlements usually occur four years after contracts are accepted. Unfortunately, the Legal Division is faced with the exact same research problem facing the RE earlier in the process, during claims resolution. Legal Division staff must first conduct research and discovery activities using the same files the RE reviewed during the claim process, and these results in the same business issue. As stated in Section 3.2.2, the lack of ability to research a central file, the inaccessibility of paper files and lost or misfiled paperwork inherent to a manual filing system create instances of excess awards and settlements.

As with claims, there has been a sharp rise in the dollar value of cases in arbitration. As of June 2004, the average dollar value of arbitration cases over the prior 3 years was \$52.5 million. In June 2001, that same 3 year average was \$23.6 million. Just as with claims, this area is of particular concern. The 123% increase over a 3 year period could result in continued escalation of costs without the proper tools to defend the state. If this rate of increase continues, it is expected that the increasing arbitration volume will only compound this problem in future years.

For the purpose of calculating this benefit, we use the same methodology used in Section 3.2.2 as the problem is derived from the same source. In this case, we apply the expected 10% savings associated with lost cases and apply that figure to the value of cases in arbitration. During 2003/04, the settlement amount averaged 41.1% of the claimed amount. The 10% savings amount is applied to the settlement amount, resulting in an expected future benefit of \$3.24 million against a projected settlement amount of \$32.4 million.

Objective	Functional Requirement
Business Objective IV Reduce arbitration awards and settlements paid by 10% by improving access to data by Legal and Expert Witness staff.	Functional Requirement IV-1 Provide a single repository to store, research, and retrieve project contract and claims, and legal documentation.
	Functional Requirement IV-2 Provide a structured data warehouse/mining capability to research project records.

Problem 5: Information system failures or processing problems are at risk of delaying progress payments to contractors resulting in interest charges to the program. The risk adjusted financial impact amounts to \$36,458 each month.

Generating payments to contractors for construction work is a mission-critical business function of the construction program. However, during the last few years the legacy system has encountered numerous problems that have delayed payments. On four separate occasions the system has either lost records or incorrectly processed contractor payments. In one of these occasions, 1,200 payments to contractors were delayed. Most of the problems were corrected quickly, but serious problems continue to arise in the CAS developed in 1968 and maintained since. As the frequency of change to the system increases, the problems are likely to arise again and Department's information technology (IT) and construction program staff may not be able to fix all of the damage. If this occurs, the Department would then be responsible for paying charges for delayed or unprocessed contractor payments.

The current legacy system (CAS) processed over 8,000 contractor payments totaling \$2.1 billion in 2003/04. During an average month, approximately \$175 million is paid out to contractors. If these monthly payments were delayed because of system problems, the late payment liability to the Department (at 10 percent²) would amount to \$1,458,333 per month. However, this figure represents the potential liability, or at risk dollars, in the case of delayed payments due to system failure. This figure must be risk adjusted to account for the frequency that the risk event (system failure) would occur.

Assessment of prior system problems encountered over the past several years yields an estimated risk factor of 2.5% to represent the frequency of delayed payment due to a partial or complete CAS system failure. The risk-adjusted benefit yields a financial benefit of \$36,458 per month.

Objective	Functional Requirement
Business Objective V Eliminate risk of interest penalty charges due to system problems or failure.	Functional Requirement V-1 Provide a stable, maintainable automated system which achieves 0% downtime during normal Department business hours.

² Statute requires late payment penalty rate of 10 percent.

Problem 6: Business function changes are not implemented because legacy information system modifications are very time-consuming.

The construction program is required or requested to gather, maintain, and provide data for a variety of purposes. Providing this data is:

- required to comply with the law (e.g. SB45 and AB1012),
- necessary to accommodate business changes such as increases in labor rates,
- requested to supply the informational needs of Department management and staff, or;
- made available to satisfy the needs of the contractor community and the public.

The current legacy system is a difficult environment to modify to accommodate changing and expanding information requirements, needs and requests.

Modifying the legacy system's programs and files is usually so expensive that Department management often decides the benefits are not worth the effort. Automation of new business processes, such as a proposed CAS enhancement to track and report on time-related overhead, have been cancelled in the analysis stage due to the large amount of time needed to modify the legacy system.

Even small changes to the legacy system can require significant time and effort to complete. For example, IT completed a project to convert one data element in CAS from a numeric format to an alphanumeric format. This relatively straightforward change required three staff members two month's effort to modify ninety COBOL programs (CAS contains 245 individual programs³). Another example is a CAS change to add two new fields to a file. This change also required three staff members two month's effort to complete. Changes to the legacy system have been accumulating so rapidly that the Department has hired contract staff to assist in making the modifications. Despite this, many changes remain unaddressed, resulting in business processes outside of the system.

One reason for the high cost of making modifications to the legacy system is that it was written in the COBOL and CICS programming languages. COBOL and CICS were once the industry standard for programming mainframe computer systems, but are now considered relatively difficult, slow, and cumbersome to use in system development and maintenance efforts. The VSAM file formats utilized by the existing systems do not offer any of the advantages of current relational database systems and limits on record sizes often require extensive programming to revise how data is stored. Available staff members with the required COBOL and CICS skills are increasingly difficult to retain, and recruiting new staff with these skills is virtually impossible. The current legacy system does not enjoy any of the technical advancements which occurred during the past 30 years, including relational database management systems, object oriented programming, graphical user interfaces, client server technology, and web-enabled applications.

Another reason for the high cost of legacy system modifications is that the system was originally developed over thirty years ago. Basic assumptions built into the original design have changed dramatically in the current business and technical environments. The system has gone through countless changes, enhancements, and upgrades and, as a result, the system is so complex and interconnected that even simple changes can require a significant coding and testing effort.

³ Virginia Bolton, Contract Administration System List of Production Programs, October 18, 2004

Objective	Functional Requirement
Business Objective VI Improve the flexibility and speed with which IT can provide system enhancements.	Functional Requirement VI-1 N/A.

3.5 Evaluation Planning

The measure of the effectiveness of a project is partially, if not totally, evaluated based upon the realization of the business benefits achieved as a result of a planned project. As a result, several key items must be in place to measure the degree that a project has either met or exceeded expectations.

At the inception of a project, the business objectives of that project must be defined in tangible, measurable terms which are meaningful to the business area affected. The key to this is the measurability of the solution. Ideally, each expected benefit would be directly related to the key measures already in place as part of the management of each program. In the absence of pre-existing measures, it is incumbent upon business management and the project team to define a new method of measuring benefits related to the project. In the case of each benefit, a baseline set of measures must be established at the inception of the project and stored with project files to ensure the original benefits can be compared to the results following project completion.

During the course of any project, the project management team must also monitor project activities to determine any changes to the expected business benefits. During the course of a long-term project, it is reasonable to expect that legislative, regulatory, or procedural changes either internal or external to the project will have an affect on some of the benefits expected. Changes could affect the degree of any benefit that may be realized, render a benefit null, or introduce new benefits not originally envisioned. Just as the benefits are baselined at project inception, the project team must maintain the expected project measures, and construct new measures, if required, to maintain an effective measurement scheme throughout the project.

Following project completion, all systems must exist in a new production environment to begin generating business benefits. This project expects to see a 3-year phase in of most project benefits (except the system risk benefit) as multi-year projects are tracked in the new system. For this project, many of the benefits will only be realized in full after data collected by the RE have been through collection and has been tested under scrutiny as part of the claims, arbitration, and audit processes. However, with a reliable set of measures maintained throughout the project, the benefits can be measured during the phase-in period and documented during the development of the post-implementation evaluation report (PIER).

The following is a discussion of the measurement of benefits within the business process.

- 1) Elimination of FINs – These notices are tracked from the time they are received. Their receipt is infrequent. The current tracking system links the project number to the FIN, and shows the specific date of the FIN. This detailed tracking mechanism is sufficient to provide the baseline measures and post-implementation documentation of whether the project achieved the expected benefit.

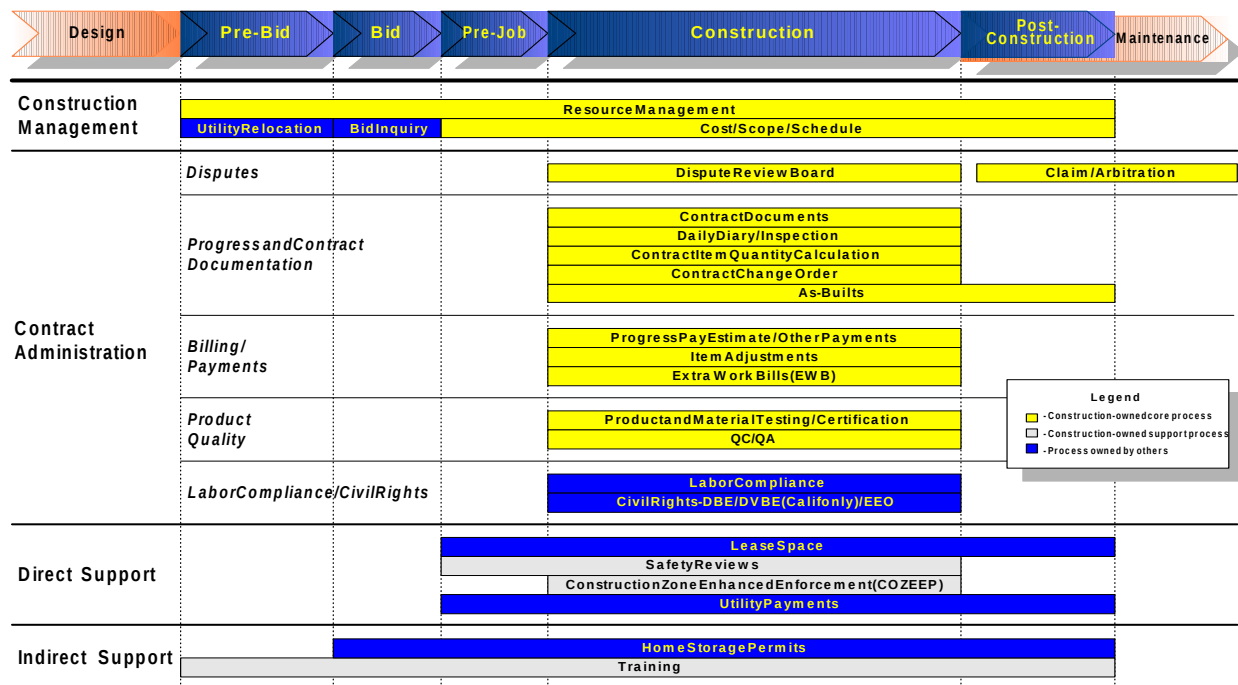
- 2) Claims Reduction – Claims are currently tracked by region, count, and claim amount, and then aggregated into a management indicators report which is updated quarterly and provided to Department management. This same report contains target measures of success regarding success in defense and timeliness of claims response. This detailed tracking mechanism is sufficient to provide the baseline measures and post-implementation documentation of whether the project achieved the expected benefit.
- 3) Claims Efficiency – The costs identified within this fiscal benefit are not currently tracked as a discrete cost item. In this case, the cost is contained within several different accounting entries, and a mechanism to establish and track this measure must be included in the project. For this study, a baseline has already been created through the use of handheld computing devices on several Toll Bridge projects. This was done on a pilot basis and specific measures were tracked regarding the cost and efficiency of defending the Department against claims. The claims defense costs were then compared between projects involved in the pilot versus those using traditional paper based tracking methods. The benefit expected is the difference between the two, and then projected to the entire statewide project portfolio. This baseline provides a sufficient starting point to measure benefits. Upon completion of the CMS project (and creation of the PIER), the project measure of claims defense costs will need to be repeated to capture a sampling of claims defense costs (research, transcriptions, and other costs) in the post-project environment. This measure will be compared to the pre-project baseline based upon the Toll Bridge projects to provide the final benefit measurement.
- 4) Arbitration Reduction – Arbitration cases are currently tracked by the Legal Division and a detailed arbitration status report is produced quarterly from the tracking list for each case. In addition, since arbitration is the next dispute step after claims, these are also tracked by region, count, and case amount, and then aggregated into a management indicators report which is updated quarterly and provided to Department management. Just as with claims, this report contains target measures of success regarding defense and timeliness of claims response. This detailed tracking mechanism is sufficient to provide the baseline measures and post-implementation documentation of whether the project achieved the expected benefit.

Section 4 - Baseline Analysis

4.1 Current Business Processes

The following diagram provides the pictorial representation of major project processes involved in the management of Department of Transportation (Department) construction projects. It is important to note that this FSR focuses solely upon the construction management aspects of the process. In other words, it does not attempt to deal with issues such as enterprise-wide project management or enterprise-wide financial management. The processes described in the following section focus upon the relevant business processes supporting the construction management from the point when the construction project begins at the construction site. In Figure 4-1, these processes are contained in the middle, under the construction and post-construction components of the diagram.

Figure 4-1 Construction Project Processes



The following section summarizes the processes as they are related to the CMS.

4.1.1 Progress and Contract Documentation Processes

4.1.1.1 Start-Up Processes

The start-up process is the first phase of a highway construction project where the construction program has primary management responsibility. The start-up process begins once the design is complete and a contractor has been awarded the contract to build the proposed improvement. The goals of the Start-Up

process are to assign the resident engineer (RE) to the project, complete all administrative requirements, and make sure that the contractor and the Department are aware of their specific roles and responsibilities before work begins at the job site.

The start-up process ensures that all administrative requirements are completed and all project participants are aware of their specific roles and responsibilities before work begins at the job site. When the contract award is official, the construction engineer (CE) assigns a RE to administer the contract. The CE assists the RE in resolving issues (e.g., obtaining additional permits, communicating with stakeholders, etc.) and setting up field offices. The RE prepares for the daily diary/inspection process by reviewing all project documentation. The RE also coordinates and facilitates a pre-job meeting with the contractor to discuss the work plan, progress schedule, safety/public convenience concerns, labor compliance, and other issues of impact to the project. The RE will usually tour the job site to take photographs and gain a perspective on the site before work begins. The RE will then establish a paper project file containing the project contract and other related documentation.

4.1.1.2 Contract Inquiry/Update Process

At the beginning of a construction project much of the contract, bid, and project information is derived from the Bid Opening System (BID) and stored in the Contract Administration System (CAS), the construction program's legacy information system. After construction begins, updates are made by the RE, such as the contractor's address, the name of the assigned RE, or the project's start date. Other updates, such as support charges and personnel changes, come from the Department's Transportation Accounting Management System (TRAMS). These updates, in turn, generate reports that are sent to the district offices, Department headquarters, and the Federal Highway Administration.

4.1.1.3 Contractor Information Input Process

During the course of a project the contractor is required to submit forms and documentation containing information on the construction project and contract. Information may be provided on any one of about 37 departmental forms, and other data may be provided using the contractor's own documentation.

Some of the forms that contractors submit during construction projects include:

- Foreman's diary
- Subcontracting Requests (CEM-1201)
- Payroll (CEM-2502)
- Statement of Compliance (CEM-2503)
- Notice of Materials to be Used (CEM-3101)
- CCO Memorandum (CEM-4903)
- Request for Payment of Materials on Hand (CEM-5101)
- Notice of Potential Claim (CEM-6201)
- Materials on Hand form
- Substitution Report for Disadvantaged/Minority/Woman/Disabled Veteran Business Enterprise (CEM-2401)
- Final Report, Utilization of Disadvantaged, Minority, Woman-Owned, and Disabled Veteran Business Enterprises (CEM-2402)
- Monthly Report, Utilization of Disadvantaged, Minority, Woman-Owned, and Disabled Veteran Business Enterprises
- Fringe Benefit Statement (CEM-2501)

When the RE receives this information they file or distribute the documents, transcribe the information into other paper documents such as the daily diary or Contract Transactions Input (CTI) form, or key the information into CAS.

4.1.1.4 Daily Diary/Inspection Process

The daily diary/inspection process includes the tasks and activities performed to record the progress of a construction project, identify and resolve problems and issues, calculate labor, equipment, and materials, and inspect the quality of the highways being built. Most of these activities are performed out in the field at the job site, and most involve hand-writing information into the paper daily diary “pegbooks” or other departmental forms. The daily diary/inspection process begins the day ground is broken at the job site and continues until the highway construction is complete and ready for traffic.

In the first step of the daily diary/inspection process the RE assigns an assistant resident engineer (ARE) to the project to conduct on-site inspection activities. Some of the inspection activities include tracking labor and equipment hours, verifying materials used, ensuring quality of work, and taking photos of the project site. All data from the inspection activities are recorded into the daily diary. Once the ARE has completed the daily inspection and recorded associated activities, the information is transcribed into a daily report form and hand delivered to the RE. The RE reviews and compiles the ARE daily reports, files one copy, and then sends another via interoffice mail to the CE.

After inspecting the work, the ARE decides if testing would required on the materials that are being used to build the highway. The Department’s testing laboratory performs these tests on the identified materials and forwards the results to the ARE for review. Once the test results have been reviewed, the ARE determines if any work must be redone. If problems are identified, then the contractor can redo the work or offer credit on a contract change order. Should the contractor not agree to redo the work or offer credit, the RE conducts a use as-is analysis to determine whether to pursue a temporary suspension of the project, remove the contractor from the project, or apply deductions from the contract amount.

All data from inspection activities are recorded into the daily dairies. This paper notebook captures all key activities, such as contractor’s progress to date, labor and equipment hours, compliant and non-compliant work, etc. This information feeds processes such as contract item calculation, progress pay estimates, claims processing, CCO processes, and post project audits.

4.1.1.5 Contract Item Quantity Calculation Process

One of the important tasks that the Department engineers do during a project is keep track of changes to the number or dollar amount of items used by the contractor. The actual number or dollar amount of items used is one of the inputs into the monthly payment process. The objective of the contract item quantity calculation process is to gather, calculate, and verify the changed item information, and then enter it into CAS as input into the monthly payment process.

During the month the RE gathers information on item quantities. There are twelve different types of item quantity transactions divided into three categories:

- 1) Contract Item Transactions
 - Contract Item Payment
 - Contract Item Quantity Balance
 - Contract Item Anticipated Change
 - Contract Item Final Balance
- 2) Miscellaneous Transactions
 - Anticipated Change

- Material on Hand Payments
 - State Furnished Materials Allotment Transfer
 - Total Allotment Changes
- 3) Contract Change Order Transactions
- CCO anticipated change
 - CCO final balance

Some of this information is found in the daily diaries, and other data is found on forms and documents submitted during the month by the contractor. The RE uses all of this information to conduct item quantity calculations. The results of the calculations are used to fill in the CTI forms, which are then used as input documents for data entry into CAS.

During system processing CAS validates the input CTI data and produces a report that lists the entered CTI information. The RE receives a copy of the report and compares the information against the original CTI data to verify that the information was entered into the system correctly. If errors are found then the CAS data is updated and the verification steps are repeated until all errors are corrected. At the end of the contract item quantity calculation process the CTI forms and the CTI reports are filed in the project documentation file.

4.1.1.6 Contract Change Order (CCO) Process

The contract change order (CCO) is the process to change a construction program contract due to increases or decreases in the amount of work, equipment, or materials that will be needed to complete a highway construction project. This process begins with a request to change or adjust the project contract and ends with an approved or rejected change order. These changes are usually the result of (1) work that was known but not biddable (supplemental work), and (2) unforeseen complications arising during the actual construction of the highway. In most instances, a project will include many CCOs to accommodate both routine activities such as supplemental work, “flagging” and other unforeseen changes.

4.1.1.7 Reporting Process

The construction program produces hundreds of reports listing information such as contractor payments, item quantities, and other construction related activities. Many of the reports are generated automatically during batch processes, and others are created by users through on-line screens or by a program support analyst using report generation software packages. Additional reports are created manually or through the use of shadow systems that contain extracts or copies of production data. This occurs when data for requested reports is not available within a single system, or the current system does not provide the necessary reporting capability.

4.1.2 Billing/Payment Processes

4.1.2.1 Progress Pay Estimate Process / Accounting Interface Process

The objectives of the progress pay estimate process and the Division of Accounting (DOA) interface process are to provide payment estimates for any work performed by the contractor during the month, including work outside of the original scope approved through the CCO process, and to generate the checks that pay the contractor.

After the CTI data is entered into CAS, the RE will prepare and mail a payment estimate request form to the district office for manual review. The district office checks for labor compliance violations and then the payment estimate request is entered into CAS. The system produces an estimate report that lists all of

the payment estimates prepared for the month. The district office reviews the estimate report to verify the accuracy of the information. If errors are found, then updates are made until all errors are corrected.

When the payment estimates are correct the requests are approved and flagged in the system. Payment information is then sent to TRAMS, and a payment tape is generated to the State Controllers Office (SCO). The RE verifies the payment estimates again and sends copies to the contractors. Certain types of payments need to be approved by headquarters before a check will be issued.

When SCO receives the payment estimate they generate check vouchers. The vouchers are sent to the DOA for further processing. The DOA applies withholds because of labor compliance violations, liens, levies, or other reasons, and then enters withhold information into the Progress Estimates Tracking System (PETS). If any stop notices are received, then the check is not issued to the contractor.

4.1.3 Project Closeout Processes

4.1.3.1 Project Closeout

The objective of this set of processes is to provide for complete resolution of all project issues, resolve all project payments, and close all files associated with the project.

Upon completion of work at the work site, the RE prepares the after acceptance (AA) estimate. This serves as the final pay estimate for all work performed at the project site. This is followed by the proposed final estimate (PFE) document which finalizes the project and is submitted both to the district director and the contractor for approval. If both parties agree with the PFE, the project proceeds through the project closeout process. However, if the contractor disagrees with the PFE, a notice of potential claim (NOPC) is submitted to the Department which documents the contractor's intent to enter the claim resolution process. Claim resolution is described in more detail in the next section.

Upon completion of the claims resolution process or upon acceptance of the PFE, the RE executes or coordinates a number of steps to closeout the project, including:

- Close Project Facilities – This step includes closing any project office space (rented trailers, etc), shutting off any utilities or phone service at the project site, and termination of any Department supplied costs at the project site.
- As-Built Plans – This step of the process ensures a complete set of files for the project, which reflects the constructed project, including all changes that occurred during the project life cycle. These plans are used in future years when assessment of structures and highways occurs. These large documents are microfilmed for storage efficiency.
- Project History Files – This step assembles and stores relevant project documents for future reference by Department staff.
- Final Project Report – This step provides a report of completion for each project, and provides this report to project staff for lessons learned and future reference.
- Prepare Final Project Estimate – This estimate is prepared following resolution of all claims or after a decision has been made by the district director. The processing of the final estimate does not wait for arbitration, if the contractor decides to pursue a claim to that level.

4.1.3.2 Claims Resolution

The objective of the claim resolution process is to provide an aid to the contract administration team to ensure that contract disputes are addressed and resolved timely and consistently. A contract dispute is a disagreement between the contractor and the Department over the need to revise the contract. Contractors submit disputes to the Department as written notices, protests, potential claims, or claims to the RE.

Dispute resolution begins by gathering facts and determining the responsibilities of the parties involved to achieve a thorough understanding of the dispute. Contractors must provide complete information in support of the dispute or risk losing the right to pursue the dispute as a claim and in arbitration. A dispute resolution process involves several steps of predefined sequences and timeframes. When receiving a written dispute notice, protest, or potential claim from the contractor, it is essential that the date and time of receipt and the name of the person receiving the written notice be recorded for future reference. A dispute that is untimely or lacking proper documentation may not be accepted. Disputes that are determined to have merit are processed as contract change orders. Those that are rejected may go into an alternative dispute resolution process, such as the dispute review board (DRB). The DRB reviews and analyzes a dispute and provides their recommendations. Although these recommendations are not binding, they are nonetheless valuable in the overall effort put together by both parties in trying to resolve a dispute before becoming a claim. These recommendations become important if the dispute is carried into claim resolution or arbitration.

A claim resolution process is initiated after the acceptance of the contract, through the issuance of the proposed final estimate. After receiving the proposed final estimate, the contractor responds either with or without a written statement of claims. If the contractor returns the proposed final estimate with a written statement of claims, the RE will review the contractor's statement of claims for conformance with procedural requirements, and will ensure that each claim, excluding overhead claims or administrative disputes that occur after issuance of the proposed final estimate, is a continuation of a previously submitted notice of potential claim.

A summary of claims document, which includes the compilation of the existing information and documents, is prepared for district construction management. The Deputy District Director of Construction uses the written information previously provided by the contractor and the RE to determine if a claim would or would not benefit from the board of review (BOR) process. A BOR is an informal meeting allowing the contractor and the Department the opportunity to make only oral presentations in support of previously submitted written information for claims identified within the BOR notification letter to the contractor. The BOR provides recommendations within the BOR report. Claims that are determined to have merit are processed through contract change orders. The contractor through the arbitration process may pursue those claims that are denied.

The arbitration process is initiated by filing a complaint with the Office of Administrative Hearing. The Legal Division handles all construction contract arbitrations. When a contractor files for arbitration, all contact with the contractor regarding the specific project must go through the designated attorney. The RE, the construction engineer, and other personnel involved with the contract, must assist in the arbitration process. This assistance may be in the form of preparing calculations, performing technical analysis, preparing documents, assisting in the discovery process, or providing testimony.

These processes are not supported by automated systems. The underlying support for the process is contained primarily in manual paper files, which contain the daily diary documents. The daily diary documents contain the many decisions made by the RE at the project site. These documents are forwarded to the district office and stored in paper form in each district office.

4.1.4 Post - Project Audit

This process has a significant impact on project funding, and the construction program's ability to respond to these audits is directly related to the completeness and accuracy of the records kept to document each project decision. These audits can be made by several entities, including but not limited to Department's Audits and Investigations, the Bureau of State Audits, and the Federal Highway Administration (FHWA), and they involve project records and decision documentation.

In the case of FHWA, an audit of project records is initiated at the submission of the final cost voucher to FHWA. A final voucher is prepared by the DOA and highlights the total cost of the construction project, proportioning those federal funds eligible for reimbursement. The final voucher is prepared at the stage of the project where all known claims and arbitrations cases are closed or settled, and there are no remaining outstanding contractual issues. This may in actuality happen years after the completion of construction on a particular project, at which time the RE may no longer be available, and document tracking and availability becomes critical. An FHWA auditor will request access to project records and will review those records for federal regulatory compliance, and a trail of decisions involving FHWA during the construction of the project. Findings of non-compliance result in a Federal-Aid Ineligibility Notice (FIN) which penalizes the Department in the current year funds expended on projects in prior years. These result in a direct dollar-for-dollar reduction in funds available for highway projects in the fiscal year when the FIN is issued.

4.2 Current Technical Environments

The construction program currently operates information systems under two different technical environments. The first environment is the mainframe environment that supports the Contract Administration System and other legacy systems. The second environment is a networked architecture containing several Oracle applications running on a UNIX operating system. These applications are linked to the Department LAN/WAN network and the Internet.

4.2.1 Contract Administration System (CAS) Technical Environment

CAS is the primary information system used to support the construction program. One of the system's major functions is to process payment estimates for individual construction contracts. Construction field and district office personnel enter payment-related data into the system based on daily diaries and contractor submitted documentation. CAS also maintains contract profile information (e.g., location, brief work description, and significant dates (contract award, work begin, work complete) and generates standard reports (e.g., project management, contract item status, CCO status, and rental rates).

The Department developed CAS during the period between 1968 and 1974. Written in COBOL, CAS operates through CICS/3270 architecture on IBM mainframes and contains approximately 325 COBOL modules in the system. In addition, as many as 600 queries have been used in varying frequency to respond to requests for information. These queries are stored as MARK IV queries.

4.2.2 CAS Technical Specifications

Table 4-2 CAS Technical Specification

Technical Area	Technical Specifications
Hardware	IBM Mainframe
Operating System	IBM MVS
Application Language	COBOL/CICS
Data Storage	VSAM files
Emulation Software	Ericom - Powerterm
System Security	RACF

4.2.3 Client-Server Technical Environment

The standard for new development at the Department is an Oracle/Sun Solaris platform. This standard was established to provide a system architecture that allows the Department to gradually migrate to a stable, scalable industry-standard computing platform. This environment is currently in place and includes the following components:

Table 4-3 Current Client-Server Standards

Technical Area	Technical Specifications
Hardware	Sun
Database Server Operating System	UNIX – Sun Solaris
Application Language	Java, Oracle Forms
Web Server	Apache
Application Server	Oracle AS, JBOSS
Database Server	Oracle
Data Warehouse/Reporting	Oracle Discoverer
Intrusion Detection	Cisco IDS
Firewall	Cisco PIX
Authentication Server	Novell NDIS

Section 5 - Proposed Solution

The proposed solution is to purchase and transfer an existing Construction Management System (CMS) from the American Association of State Highway and Transportation Officials (AASHTO). The system would then be modified to meet the California Department of Transportation's (Department) specific construction requirements and departmental technical standards. As is, the AASHTO system addresses all of the Federal Highway Administration (FHWA) requirements and most of the Department's construction business needs. However, and as a first step in the development of the software design document, a thorough analysis of the AASHTO system will be conducted to identify areas of needed improvements specific to construction processes or contractual obligations unique to the Department.

Previously, other states were faced with similar problems as those experienced in California. One base system, supported and maintained by the AASHTO, has been successfully implemented in multiple state transportation agencies across the country. While initially it seemed preferable to simply attempt to just procure and install the basic AASHTO solution, several significant difficulties have come to light. First and foremost, the solution would result in an environment less flexible than the one currently in place within the Department. All changes to the AASHTO standard software must be approved by a committee of states' representatives annually, and it utilizes a maintenance contractor under a federal contract that provides for only a single maintenance cycle of the software each year. This type of cycle is far less flexible than that which the Department currently has, yet the current needs are not being met. In addition, if California's specific requirements were not prioritized at the top of their list, it is possible California's specific requirements would never be addressed. Second, the AASHTO software application currently resides on a development platform not currently supported by the Department. This barrier could be overcome; however it does come at a significant cost of maintaining a larger staff and separate infrastructure that would be dedicated only to this single application.

The concerns in working with this software have been solved previously, allowing the Department to leverage the lessons learned by other states. Recently, the state of Wisconsin proved the path we are recommending. With AASHTO's approval, they received a base copy of the code. Subsequently, they hired a separate vendor to perform state-specific modifications to the application. Since that time, the vendor has successfully implemented state-specific changes and Wisconsin now maintains their own version of the application for their own use.

This solution has also been proven to operate in an environment of comparable size to that of California. During the study, the team contacted both Texas and Florida, two of the largest other states. Both utilize state-tailored versions of the AASHTO software. In the Texas case, the state maintains at least as many miles of highway through their application and has shown the application successfully supports their needs.

For California, the proven path and scalability provides some assurance that the recommended solution follows a path that is proven and lowers the overall risk of the project. In addition, the base software is available both for desktop access and in a handheld version that the resident engineer (RE), and assistant resident engineer (ARE) can use in the field. However, as we have stated the solution is not currently compatible with the Department's infrastructure.

Functional evaluation of the system indicates that the current functionality of the AASHTO software, and other state-tailored versions, exceed those currently contained in the Contract Administration System (CAS). However, the current CAS and Construction Unit Cost (CUC) systems must still be analyzed in

detail to ensure that CMS will incorporate both the unique functionality of CAS and CUC, as well as the advantages of the source AASHTO application. Currently, the AASHTO software already provides the following functional capabilities:

- Contract Initiation
- Contract Management
- Progress Pay Estimates
- Extra Work/Change Orders
- Payment Processing
- Claims/Arbitration
- Workflow Management
- Reporting
- User Management
- Single Database
- Search and Retrieve
- Code Table Maintenance
- System Alerts and Notifications

In addition, an add-on handheld module provides the mobile computing capability. Since this is an add-on component of the same application, it is already designed to work with the database within the base system, minimizing many of the integration issues associated with having to custom build, and then integrate a separate handheld application.

Required Modifications

The following areas will need to be completed during the course of implementing the solution:

- Design and development of unique Department business requirements
- Design and development of contractor web-based interface requirements
- Conversion to the Department's standard infrastructure
- Replacement of the functionality of current CAS/CUC batch routines in the new CMS
- Conversion of current CAS/CUC interface capabilities to the new CMS, including the following systems:
 - BID system – winning bid and contract item data
 - PMCS – project data and site data
 - TRAMS – support charges, personnel data, and payment transaction data
 - BEES – unit item description data
 - State Controllers Office (SCO) – payment tapes
 - Transportation Program – payment data and fund distribution data
 - BBA – low bid item cost and item description data

Improvements to the Existing Automated System

The CMS project will make several improvements to the construction program's automated business system. More flexible and customizable reports will be able to be produced on-request, new query tools will be available to search through the database, and the Project Estimate Tracking System (PETS) sub-system of TRAMS will be incorporated into CMS to allow increased functionality and ease of use.

Reporting Enhancements

The current legacy CAS and CUC systems produce several hundred different reports for a variety of business purposes. Many of these are generated automatically, and others are produced on-request through CAS. The on-request reports are limited to a set of the most commonly used reports, and the users cannot customize them.

The CMS system will enhance the current on-request reporting process to provide a wider variety of reports, and allow the user to specify criteria to filter and select the data that is used to produce the reports. For example, a user may want to generate a listing of all the claims in a certain district between a set of dates. The current legacy system can only provide this information if the user makes a special request to the CAS system support team at IT. With the new CMS reporting request process, the user will be able to produce this information on their own and in less time.

New Query Capabilities

The CMS will give Department staff greater access to the construction program data than was possible in the legacy mainframe environment. The data in CMS will be maintained in an Oracle database that has open database connectivity (ODBC) capability allowing it to be queried via software such as Seagate Crystal Reports, Microsoft Excel, or Oracle Discoverer. Users will be able to generate customized reports using the data for their own program's business needs.

Electronic Daily Diary

The CMS project will implement a new electronic daily diary system⁴ to allow the RE the ability to record project and contract data on a mobile device, and then transmit the data electronically into the CMS database.

The CMS project will allow the user to enter diary information while out at the job site. The RE, ARE, inspectors, and structural engineers will be provided with a mobile application to record the labor, equipment, and materials used, the weather and working conditions, and other information important to the project. The information can be entered while at the job site, so the paper notebook used by the RE for over 60 years will no longer be necessary. When the engineers return to their offices the electronic daily diary data will be uploaded from the mobile application directly into the CMS database. Once in the CMS database the daily diary data can be used as input to the item quantity calculation process, support material in claims research, and input data for labor compliance and DBE reporting.

Contractor Information Input Process

Contractors may be required to submit up to 37 different construction program forms during the life of a construction project. The CMS project will provide a new set of screens and processes that allow contractors the ability to enter contract and project information directly into the CMS database through either the construction program's Internet web site or through direct data file transmissions from the contractors' information systems to the CMS database. The goal is to provide contractors the ability to submit any construction program form electronically that they currently submit on paper. This section will contain all of the forms that a contractor is required to complete and submit. To begin the process the contractor will access the web site, enter in a user ID and password, and submit needed information for the construction project currently in progress. The data will be entered into fields on the screen, and the system will perform validation to ensure accuracy before electronically submitting the information to the CMS database.

⁴ The construction program conducted a detailed business requirement analysis to determine the specifications of a portable electronic daily diary system. This study was completed in February 2001.

The second method to submit data is for the contractor to transmit the data directly into the CMS database using an electronic file transfer. The contractor will create the data on their own PC or information system and then send it to the Department via a file transfer protocol (FTP), or similar process. The CMS system will be designed with flexible, standard extensible markup language (XML) message formats, following national standards where applicable, to facilitate message based interfaces of the future within the Department.

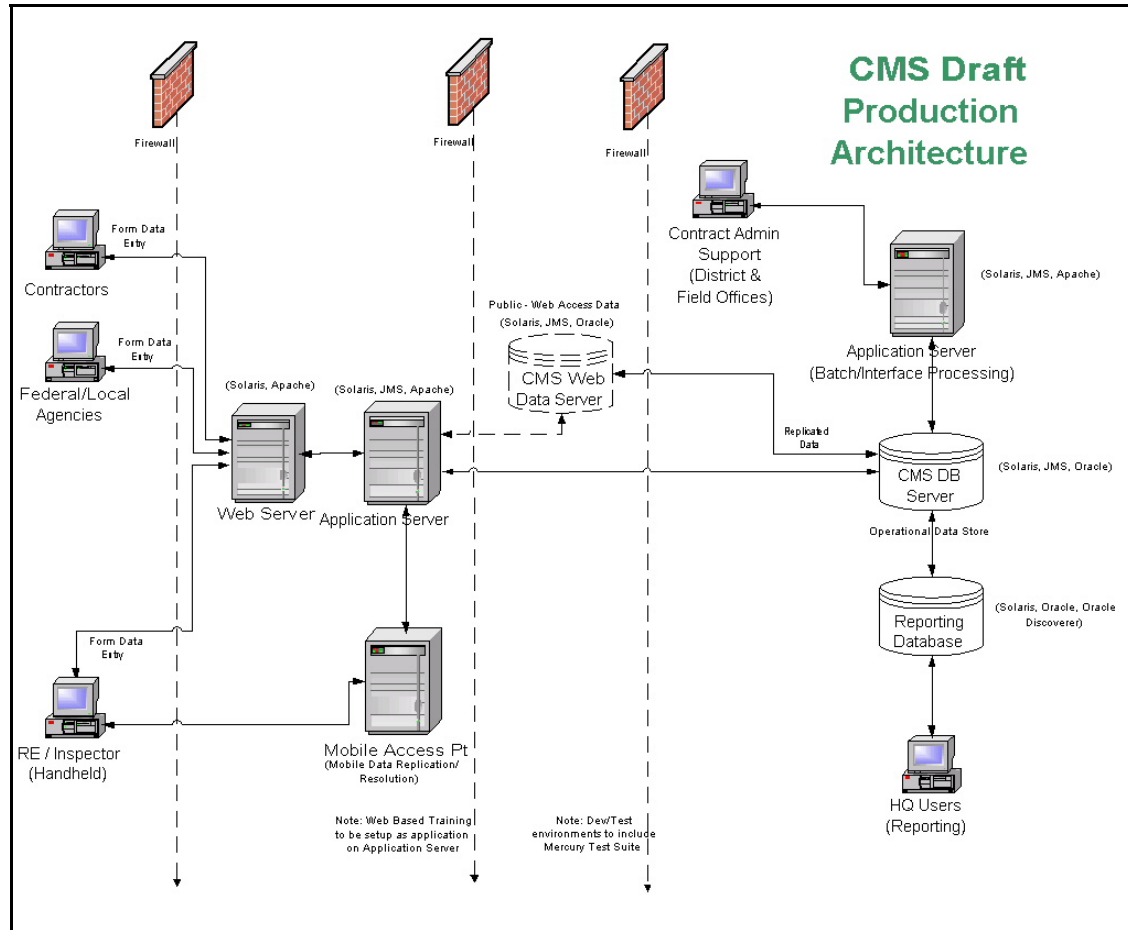
5.1 Solution Description

5.1.1 Hardware

The CMS project hardware solutions consist of three major components:

- 1) *Web-based CMS infrastructure* – including industry standard web architecture, providing web, application, and database layers of the application. For CMS, this will include an additional application server for the purpose of interface and batch processing.
- 2) *Desktop Application infrastructure* – including industry standard personal computers and peripherals, providing increased web, application, and database access for data input and retrieval for field and district office contract administration support.
- 3) *Mobile Application infrastructure* – including the mobile computing devices and the infrastructure to extract, transmit and post data from the mobile application into the CMS database.

Figure 5-1 CMS Draft Production Architecture



The CMS project will not require upgrading the following:

- Existing client PCs and printers
- Information technology communications infrastructure:
 - Switches and routers
 - Local Area Networks
 - Wide Area Network
 - Communications-related software

Mobile Application Hardware

The CMS project will purchase approximately 100 desktop PCs for increased access by REs and inspectors, and 2,310 mobile devices for use by the RE, the ARE, inspectors, and structural engineers to support the mobile CMS application. Please note this number is above the 2,200 estimated to provide a 1:1 ratio of devices for each RE, ARE, inspector or structural engineer. This provides a 5% surplus inventory in recognition that these devices will be placed into a physically demanding environment at each construction site that will likely result in damage to some devices. The surplus inventory will allow the Department the ability to deploy a new device to the RE without requiring the RE to go without the mobile device for a great length of time.

Currently, departmental standards exist for all hardware components within the CMS architecture except the mobile computing devices. As a result, standards and specifications supporting the mobile application will be included in the design phase of the mobile application development. The general guidelines in place for the purchase of these devices are as follows:

- The hardware must provide the ability to enter text using either a keyboard, stylus, or by handwriting on the screen
- The hardware must be able to store sufficient data to support all active projects that a RE is responsible for monitoring
- The hardware must be lightweight and portable, operate on a battery and AC, and be handheld
- The hardware must be durable under construction conditions such as dust, heat, impact, and moisture
- The hardware must provide an interface to be able to both send and receive data to and from the base CMS application

The mobile application will require a communication server to receive and send data between the database and the mobile devices. This machine will have a server application necessary to support data replication, validation, conflict resolution (preventing conflicting updates), and communication.

5.1.2 Software

As with hardware, The CMS project software solutions consist of two major components:

- 1) *Web-based CMS infrastructure* – including industry standard web architecture, providing web, application, and database layers of the application.
- 2) *Mobile Application infrastructure* – including the mobile computing devices and the infrastructure to extract, transmit and post data from the mobile application into the CMS database.

Web-Based CMS Application Software

The AASHTO System is currently a client server based application. A contractor interface is not available for input or review of contract information. Some state transportation agencies have allowed secure access to contract inspectors, through a dial-up or VPN connection. However, the CMS will be a web-based application providing controlled on demand access to contractors and funding partners, in addition to departmental staff. The web-based CMS application will utilize an Oracle database with Java, hypertext markup language (HTML), and Oracle Forms used to create the web pages for the web based application. Java will be used to program the application and database layers of the application and, where required, Java Messaging System (JMS) will be used to control messaging and workflow between each platform until an enterprise application integration (EAI) platform is available through the Integrated Financial Management System (IFMS). Oracle Reports and Oracle Discoverer will be used to create the pre-packaged reports and to provide ad-hoc reporting capabilities.

Mobile Application Software

The CMS project will transfer and modify the existing mobile application currently supported by AASHTO, and modify the application for the specific departmental requirements. The specific mobile software packages will be determined during the course of the project and will include the following general requirements:

- The software must be maintainable by Department staff
- The software must be J2ME (mobile extensions of the J2EE standard), allowing the Department to leverage its current Java skill base

- The software should be able to run on a variety of hardware devices
- The software should support a database large enough to contain data for all of the projects

5.1.3 Technical Platform

Web-Based CMS Technical Requirements

The proposed solution is consistent with the Agency Information Management Strategy (AIMS), the Department's enterprise model and standards, and technical areas of expertise. The following describes the proposed solution's technical requirements.

Table 5-2 Technical Environment

Technical Area	CMS Host System
Server Hardware Platform	Sun Solaris
Database Management System	Oracle
Database Server Operating System	UNIX – Sun Solaris
Application Server Operating System	Sun Solaris/Oracle Application Services
Web Server Operating System	Sun Solaris/Apache
Client Operating System	Any Web Browser, Windows NT
Development Environment	J2EE/J2ME/Java, Oracle Forms, HTML
Mobile Computing Platform	To Be Determined (during technical design of this project)
Interfaces	XML Format (data), JMS (Message Processing) (In the future, when the Integration Study results are being implemented, XML messages will be processed by the EAI platform included in the Integration Study recommendations)
Reporting	Oracle Discoverer
LAN Topology	100 Mb Ethernet
Network Management	HP Openview
Asset/Change Management	Novell Zenworks
Virus Protection	TrendMicro
Intrusion Detection	Cisco PIX

5.1.4 Development Approach

This project will be developed as a partnership between the construction program and the Department's information technology (IT). The CMS project will utilize existing IT Project Management Methodology and Application Development and Maintenance manuals in its development.

5.1.5 Integration Issues

The Integration Study recently completed by the Department specifies standard communication formats and processing platforms, which are expected to integrate with the CMS, once the IFMS is developed. As the Integration Study shows, the primary point of interaction between CMS and IFMS occurs at the point when the CMS will generate payment triggers. Under CMS, these triggers will be formatted as standard XML messages and will be sent to TRAMS for processing. When IFMS is up and running, it will be able to simply process the same XML message already in place.

The Integration Study also proposes a standard enterprise application integration (EAI) suite of tools. This suite would provide a standard messaging platform to receive, route, and manage all interface messages between systems and would replace the current point-to-point interfaces in place within the Department's systems. The EAI platform is not expected to be in place at the time when CMS is implemented. To account for this and minimize the impact to both projects, CMS will temporarily utilize the JMS (a free extension of the Java tools available from Sun Microsystems), to provide similar functionality. While JMS does not provide a full suite of capabilities that a standard EAI platform can offer, it does provide a standard messaging interface and processing capability for XML messages that can easily be replaced by the IFMS without requiring modifications to the CMS application. The only requirement will be to change out the message processing platform, which is separate from the creation of the XML messages within CMS.

5.1.6 Procurement Approach

Due to the size of the project, the Department has included the services of an acquisition specialist for the procurement phase to assist in producing the required procurement deliverables and execute the procurement process on the Department's behalf.

The CMS project's proposed solution will require multiple vendors for the development effort. It is necessary to separate the decomposition of the AASHTO software (that will provide the detailed specifications and data model) from the subsequent design and build of the new application. By using different vendors, the Department will ensure that no conflict of interest occurs and the resulting application meets the department's needs in the most cost effective manner.

During the procurement period, Independent Project Oversight Consultant (IPOC) and Independent Verification and Validation services (IV&V) are included to provide the necessary external review and guidance to ensure the Department is getting the best value for its dollar and compliance with State processes and procedures.

In addition to the procurement of a prime services vendor for the development of CMS, additional procurement activities will occur during the project. The Department will use the State's procurement vehicles such as the California Multiple Award Schedule (CMAS) or Master Services Agreement (MSA) to procure the services of the CMS project manager, IPOC, IV&V, acquisition specialist, and hardware and software for the project.

5.1.7 Technical Interfaces

The CMS will have electronic interfaces within the construction program, with programs and sections within the Department and with contractors and agencies outside of the Department. The interfaces are divided into inputs and outputs.

The CMS application will contain the following electronic input processes:

- Mobile Application uploads
- Contractor information electronic file transfers

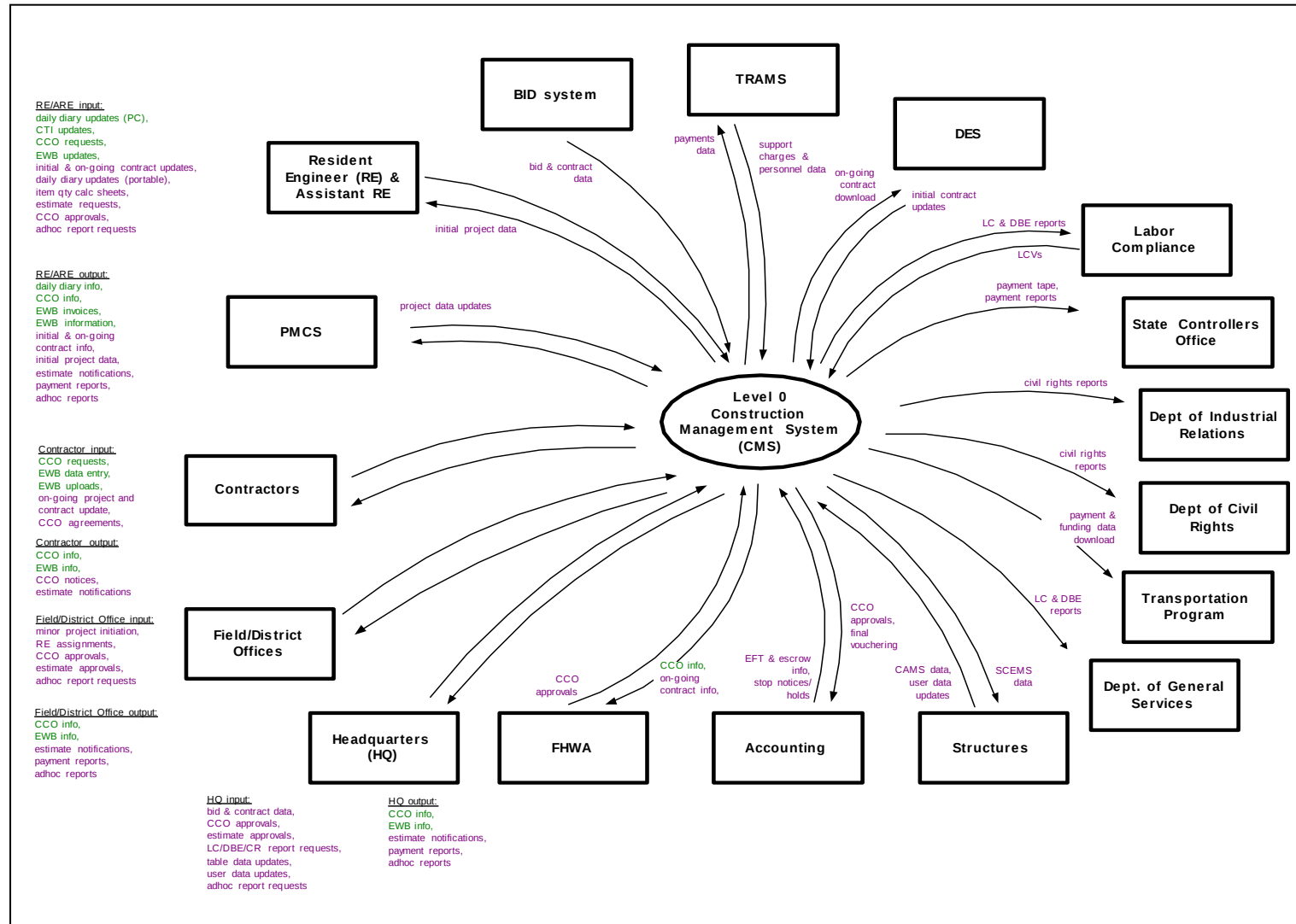
- BID system – winning bid and contract item data
- PMCS – project data and site data
- TRAMS – support charges, personnel data, and payment transaction data

The CMS application will contain the following electronic output processes:

- Mobile Application downloads
- BEES – unit item description data
- BID – unit item description data
- PMCS – project data
- TRAMS – payment transaction data
- Division of Engineering Services (DES) – Structure Construction databases
- State Controllers Office (SCO) – payment tapes

Figure 5-3 on the following page is a data flow diagram showing all the interfaces, including the technical interfaces, proposed for the CMS. Note that many of these interfaces currently exist or are currently in development.

Figure 5-3 CMS Data Flow Diagram



5.1.8 Testing Plan

The CMS project will conduct several testing phases to ensure the accuracy, completeness, and robustness of the processes. During the course of the project, the prime vendor will be required to create a comprehensive test plan for the project to describe the scope, processes, and procedures necessary to test the entire application.

Within the test process, the Department utilizes Mercury Interactive suite of test tools to improve the productivity of application testing. This also provides Department staff with a reusable set of test scripts with which to maintain the application following transition to maintenance. The development of these automated test scripts is included in the cost estimates for the prime vendor.

At a minimum, the following phases are expected to be executed during testing:

Unit Testing Phase

The technical team will unit test each of the processes and functions developed for the CMS. Unit testing is defined as the verification of the accuracy and completeness of the individual processes, programs, and procedures that make up the CMS.

Integration Testing Phase

Integration testing will be performed to verify that the newly developed CMS applications work with the construction program applications and tables already existing on the Oracle/Unix platform. This is also the phase when the daily diary upload/download process will be tested.

Performance Testing Phase

The technical team will conduct performance testing to verify the robustness of CMS. Performance testing, which is often called stress testing, will be used to test how the system responds under heavy processing or data loads. An example would be to process twice the normal number of contractor payments during a single progress pay estimate process.

System Testing Phase

System testing will be conducted to verify that the CMS system works correctly as a complete system, including all of the external interfaces processes and email notifications.

User Acceptance Testing Phase

User acceptance testing is the phase where users from the construction program who have not been directly involved with the CMS project are used to test the CMS by performing their normal daily tasks and activities in an environment that almost exactly matches production. User acceptance testing is helpful in identifying problems that may occur when the system is used differently than documented in the specifications.

5.1.9 Resource Requirements

Executive Support

Throughout the project, active and direct project support will be necessary from district and headquarters management to maintain focus, display support for the project to staff, and to actively involve

stakeholders in project issues and resolutions. Executive support will be provided in two layers. First, the steering committee will be staffed by a minimum of the project sponsor, two representatives of IT, the Construction Division Chief, and two district representatives. Second, briefings will be provided to the Department's executive management as a portion of the monthly project reporting.

Project Manager

The CMS project will have a dedicated, full-time project manager (PM) to manage the overall project. The PM will be a CMAS contractor, reporting directly to the project sponsor and Department's executive management included within the project steering committee, which will be comprised of the two project sponsors and management representatives from the user community. The PM will receive assistance from the IT Project Management Office (PMO) on project management activities, and support from an administrative assistant to track, handle, and communicate the volumes of risk, issue, plan, and project documentation necessary to properly manage the project.

Acquisition Specialist

The CMS project will include a large one-time procurement process in order to engage a vendor experienced with development of applications similar to CMS within other transportation agencies. Considering the resource constraints of DGS, the project will require an acquisition specialist familiar with the state procurement policies, processes, and regulations to create the bid requirements and all procurement phase deliverables under the direction of the PM. The acquisition specialist will be a CMAS contractor approved to provide services to the state under the acquisition support service classification.

Prime Vendor

The prime vendor will report to the CMS project manager and will have responsibility for creating of analysis, design, development, test, and implementation deliverables for both Phase 1 and Phase 2. The prime vendor will be responsible for hardware/software specifications; however, purchase of these resources will remain a state responsibility.

Independent Project Oversight Consultant

The independent project oversight consultant (IPOC) will have dual reporting responsibilities to the Department of Finance (DOF) and the Business, Transportation and Housing Agency (BT&H), including the publication of formal independent project oversight reports (IPOR) consistent with the project oversight framework as specified on the DOF website.

Independent Verification and Validation

The independent verification and validation (IV&V) vendor will report to the CMS Project Manager and will be responsible for independently reviewing project activities and reporting their findings to the project manager, IPOC, and if needed, directly to the steering committee. The IV&V vendor will be primarily responsible for business and technical review and assurance within the day to day project activities and deliverables. Review and guidance at the project management level will be within the responsibility of IPOC.

5.1.10 Training Plan

The CMS project will conduct training for approximately 3,000 Department staff and over 1,000 contractor staff in how to use the new CMS application and electronic daily diaries. Training will be conducted in phases during implementation, and is expected to take about five months to complete.

CMS training will be divided into three general areas: 1) CMS application training for Department staff, 2) CMS training for contractors and outside agencies, and 3) Mobile Application training for REs, AREs, inspectors and structural engineers.

CMS Application Training for Department Staff

Training will be conducted to instruct Department staff on how to use the CMS application. The topics to discuss and demonstrate will include:

- Differences between CAS and CMS
- Navigating in CMS
- CMS business processes
 - Start-up process
 - Contract inquiry/update process
 - Contractor information input process
 - Electronic daily diary PDA process overview
 - Progress pay estimate/other payment estimate processes
 - Accounting interface process
 - Reporting requests
- System alerts and email notifications

CMS Training for Contractors and Outside Agencies

Training will be conducted to instruct contractor and outside agency staff on how to use the new CMS functionality. The topics to discuss and demonstrate will include:

- Web site overview
- Contractor information update
- File transfer processing
- Email notifications
- Reporting process

Mobile Application Training for Engineers

Training will be conducted to instruct engineers on how to use the mobile application and mobile devices, including how to create and update data in the electronic daily diaries. The topics to discuss and demonstrate will include:

- Using the Mobile Application
- Entering data into the Mobile Application
- Uploading and downloading data
- Synchronizing with the host system
- Hardware maintenance

For all training the CMS project will implement a “Train the Trainer” (T3) approach. In a T3 training approach, a subset of employees are trained on the new solution and instructed on how to train their peers. This is a cost-effective way of training an organization on a new application as it avoids the expense of individual travel and training for all users.

All training materials for the CMS application will be created using a web-based training (WBT) tool. While the initial training will be delivered in person using the T3 approach, this will allow the Department to deploy a WBT component of the CMS application. In the future, any new employee and/or contractor can “self-train” through the use of the WBT component, or use it to “refresh” themselves in the use of the application.

5.1.11 Ongoing Maintenance

IT and the construction program staff will provide ongoing maintenance. Ten positions will be required to support the workload associated with maintenance and operation of the CMS application. Current staffing allocations dedicated to the support of CAS and its related sub-systems involve a total of 7.5 PYs for help-desk duties and application maintenance, and 1.0 PY for network operations support. These 8.5 positions will be supplemented by a 1.5 PYE in on-call consultant services to provide business related enhancements in support of construction operations. The ten positions associated with CMS ongoing maintenance are identified as follows:

- Business Help-Desk staff (3) – To handle additional help desk call volume expected by the expanded application and new external construction users
- Oracle Database Administration (1) – To provide additional support for the Oracle databases and Oracle tools included in the application
- Application Development (2.5) – One and half positions will be focused upon Java/Web-Based CMS maintenance, and one position will support the Mobile application (this position will require J2ME specific training)
- Network/Server Support (1) – One position to handle administration of the new infrastructure
- Test/Quality Assurance (1) – One position to maintain automated test scripts and conduct maintenance testing
- Application Enhancements (1.5) – One and half positions equivalent in on-call consultant services to enhance or modify the CMS to reflect changing laws, regulations or practices, and provide for upgrade in related technology.

These staff will require specific technical training beyond the application training described in this section. Within the project budget, technical training classes have been planned to help ramp up these staff and to become proficient at supporting the application. In addition, the staffing presented in Section 8 includes a six month overlap between the start of these positions and the end of the project. This will allow the new staff to work alongside the project team during the latter days of the project and perform knowledge transfer to ensure a successful transition to maintenance.

Production maintenance tasks will continue on the existing systems throughout the development process. However, only limited enhancements will be made to the existing systems during the course of the CMS

project. Following approval of the FSR and development of the detailed project plan, CAS will be limited to emergency enhancements. This limitation of system enhancements frees up some of the existing support staff time. As the project moves forward, these same support staff personnel will work on the development and data conversion effort.

5.1.12 Information Security

CMS Application Security

The CMS project team will define and implement appropriate levels of application and data access to the CMS for the various functions within the construction program and for any departmental functions that require access to construction program data. The database and applications servers will be housed in the secured information technology computer room at the Department's headquarters. The servers are account and password protected consistent with departmental security standards. The standard WAN/LAN network security system will be implemented, utilizing existing firewalls, intrusion detection, virus protection, and activity tracking.

Mobile Application Security

The mobile application will require a separate information security program. Business requirements are currently being developed, but will include the following:

- The mobile application will be secured by requiring a user ID and password. The user ID will accompany any data entered into the system.
- Data transfers will be encrypted to avoid hacking/modification of data while in transit
- Mobile application entries will only be created or updated by the RE or ARE responsible for the contracts.
- Location based services will be utilized to track the location of each mobile device and prevent against device theft.

Contractor Information Input Security

The contractor information input security process and procedures will be the same as were established for the construction program's current web site that allows data entry of extra work bills by construction contractors.

5.1.13 Confidentiality

None of the data to be stored in the CMS database is considered confidential. Nevertheless, confidentiality is required from any involved vendors, construction program, and IT staff. All vendor contracts will include confidentiality agreements. In addition, the system will include a user management feature which will provide all external users with a unique id. The system will audit all activity for each user id to ensure an accurate log of each users activity is kept in the event of any dispute regarding creation or update of vendor information.

5.1.14 Impact on End Users

While the CMS does not include business process re-engineering activities, the CMS project will replace manual, paper-based processes with automated form entry through the web and mobile computing devices. This will have a significant impact on the daily steps staff executes each day while carrying out their jobs. The impact to the end users of CMS necessary to realize the improvements in the construction program will generally be in the following areas:

- Paperwork will be reduced and can be created directly at the job site
- The RE can document agreements with the contractor directly at the project site, reducing the future disagreements over decisions which occur at the job site.
- CMS screens will be easier to use and navigate than the legacy system
- There will be greater access to construction program data
- Reporting will be more useful and flexible
- There will be faster turnaround on system change requests

5.1.15 Impact on Existing System

The CMS project will replace the CAS, CUC and WCCP systems. During implementation the CAS and CUC systems will be running in parallel with the CMS. CMS will be phased in over several months so the processing load on CAS and CUC should decline during the implementation phase until the end of the project when CAS and CUC will be retired. The WCCP system provides a report published to the Internet with details of monthly construction contract payments. There will be no need for WCCP and CMS to run concurrently – WCCP will be retired when CMS goes into Phase 1 production.

5.1.16 Consistency with Overall Strategies

The proposed project is referenced in the Department's current Agency Information Management Strategy (AIMS) document and the Department's strategic business plan. This project is also consistent with the State's strategic direction for information technology, including the usage of the internet to conduct more business between our constituents and government.

5.1.17 Impact on Current Infrastructure

The existing server and database hardware environment is not sufficient to provide for the CMS application and will need to be supplemented to provide sufficient capacity to support CMS. The existing network infrastructure has sufficient capability and capacity to incorporate the CMS application. As the CMS is developed, testing will be performed to validate all architectural components of the application and determine if any changes in assumptions or additional application capabilities have created unforeseen system load beyond that which has been planned during budgeting included within this FSR.

The CMS is not expected to place significantly greater demands on the WAN, LAN, or desktop than the legacy systems and processes it will replace. At the moment, large data transfers occur regularly to move data between the many disparate systems. With the removal of these data transfers, the additional load created by CMS is not expected to exceed that which is currently placed on the network.

5.1.18 Impact on Data Center(s)

The CMS project will move mainframe applications and databases from the Teale Data Center except those processes required to create a payment tape for the State Controller's Office. During the CMS implementation the mainframe applications and data will be migrated to the CMS system over several months. The project is estimated to incur \$140,000 in one-time costs associated with services provided by the Teale Data Center. These services include assistance in transferring existing data from Teale Data Center files to the new CMS database, archiving legacy programs and files, and discontinuing scheduled batch processes and on-line environments. On-going Teale Data Center costs will eventually be reduced to approximately \$3,600 per year starting in fiscal year 2008/2009. This fee will be primarily for providing payment tapes to the State Controller's Office.

5.1.19 Data Center Consolidation

There is no expected impact on data center consolidation.

5.1.20 Backup and Operational Recovery

Backup and recovery will be provided by the Department's existing enterprise backup and recovery tools (such as Veritas). The existing backup and recovery services, including infrastructure and staffing are sufficient and will be utilized for CMS. The system web, application, and database servers will have redundancy built into the application processing with load-balancing capabilities to eliminate a single point of failure from the system.

Disaster and operational recovery will make use of the existing high-reliability networks currently in place within the Department, including leveraging the infrastructure at the Department's Transportation Management Centers (TMC). The planned hardware redundancy provides initial assurances that the system won't fail due to a single point of hardware or software failure; however it is only one step. In addition to this, the servers will be backed up daily, following a schedule for archiving, full backups and incremental backups. Backup and archive data will be transmitted to an offsite storage facility. Database changes will also be replicated to the TMC environment to ensure they are immediately available should the primary computing site be destroyed or inoperable for any reason.

The Southern California center is in a geographically diverse area of the state, reducing the likelihood that a single disaster would affect each site. To provide for prompt operational recovery, hardware will be available at the site for immediate deployment in the case of a necessary recovery.

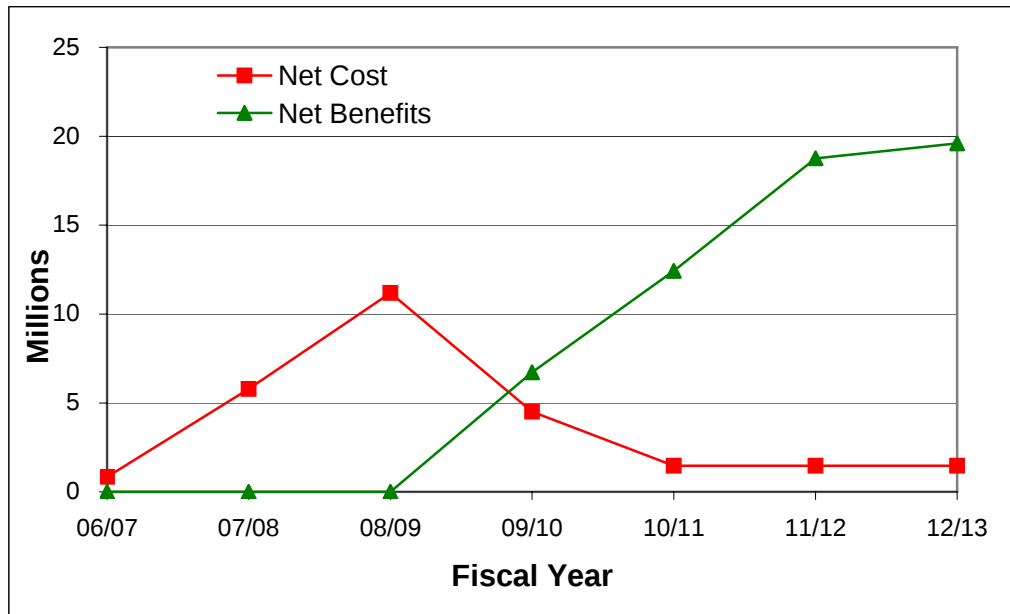
5.1.21 Public Access

The CMS project will include access to information through a departmental website utilized to conduct business with the contractor community. All access to this site will be secured through secure communications and the site will be secured with application level user and password capabilities. This is consistent with the State's goals of conducting more business through the internet, where feasible.

5.1.22 Costs and Benefits

The net project costs and benefits are depicted within the graph that follows. Following the transition to production, the system delivers a net benefit ratio of approximately 13.4 to 1, delivering \$18.8 million in benefits each year with a cost to maintain the benefit of \$1.4 million. The breakeven point for this project occurs within the first full year of production following completion of the implementation phase of the project. Assuming the schedule as described in Section 6, the Phase 2 implementation will occur in the 2009/10 fiscal year, with the breakeven point occurring by October 2011.

Figure 5-4 Cost/Benefit Graph



Costs

The one-time and on-going costs are summarized in Table 5-5 below. These costs are also incorporated in the Economic Analysis included within Section 8.

Table 5-5 Summary of Project Costs

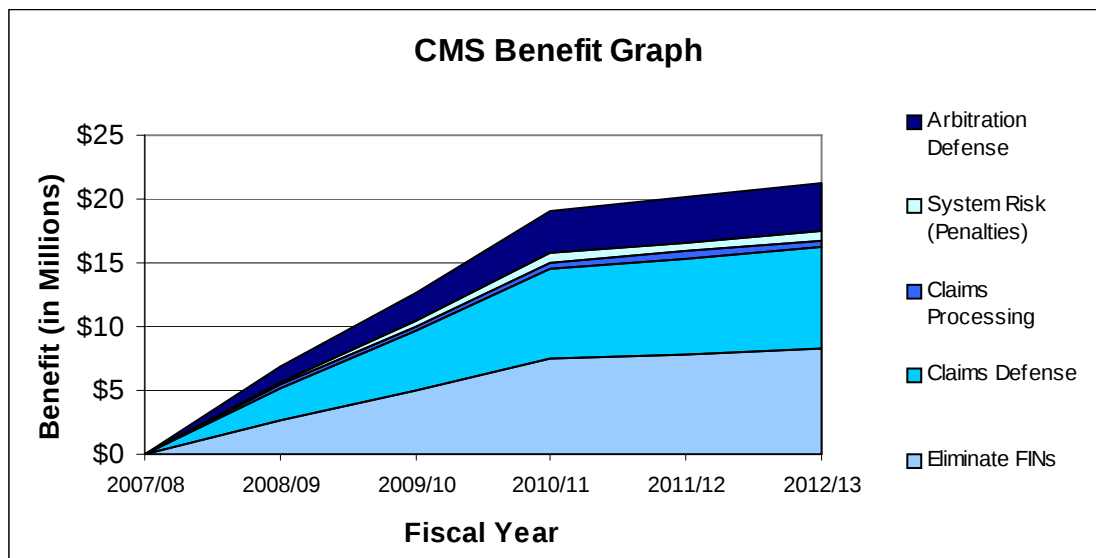
	One-Time Costs	Ongoing Costs (per year)
Staff	\$2,053,808	\$679,000
Hardware	\$1,121,907	\$253,487
Software	\$239,344	\$175,869
Contract Services	\$17,218,359	\$250,000
Data Center Services	\$140,000	\$3,600
Totals	\$20,773,418	\$1,361,956

Benefits

The proposed solution will allow the construction program to achieve all of the benefits outlined in the business objectives of this project. The CMS project is estimating an annual benefit of **\$18.8 million**. Note that this amount is achieved in the third full fiscal year following implementation of the system, when all projects have been tracked in the system since inception. Benefits start to accrue with the initial implementation, however our analysis indicates it will take between 2 and 3 years to achieve full adoption of the automated systems which will generate savings associated with post-project processes. The full benefit amount is expected to be in year 3. The benefits are estimated to phase in on a steadily increasing scale at 40% the first year, 70% the second year, and full benefits during the third full year of production.

operation. Note that these benefits will result in net savings of capital funds that will be available for additional capital projects as the benefits are realized, improving the overall efficiency of capital expenditures on state highway projects. The projected Cost Benefit Graph for this project is depicted below and results in an ongoing benefit-cost ratio of 13.4 to 1 after the system has been fully implemented. Benefits associated with staffing workload efficiencies, as a result of this application, will be reflected in future project related work plans. These work plans constitute the basis of the Department's fiscal zero-based support budget for project delivery.

Figure 5-6 Benefit Graph, by Benefit



5.1.23 Sources of Funding

The project will be funded through budget augmentation to the State Highway Account as specified within the project budget as shown within Section 8 of this FSR.

5.2 Rationale for Selection

Only two solutions offered a complete solution to the Department, a) development of a custom application, or b) transfer and modify an existing solution (from another state transportation department). Both solutions would fully meet the requirements as they can both be developed to the Department specification. However, cost analysis indicated the one-time cost of the custom application is approximately 35% higher than the cost of the transfer and modify alternative. With no difference in benefits or maintenance cost, or perceived risk, the Department selected the lowest-cost solution.

The costs of the alternative solution are included in Section 8 for economic analysis.

5.3 Other Alternatives Considered

Rejected Alternative 1 -- Continue current business process and accept the limitations

The construction program management is developing the CMS project because the current business processes are out-of-date, inefficient and ineffective, and at an increasing risk of failure. Therefore, maintaining the status quo is unacceptable.

Rejected Alternative 2 -- Purchase off-the-shelf software

During the course of analyzing requirements and studying the business needs, the Department researched the industry, contacted a list of software vendors known to provide solutions to the construction community, and contacted several other transportation agencies (including AASHTO, Texas, Florida, and Wisconsin). During the course of these inquiries, only one solution was identified which provided functionality necessary to manage a state transportation contract management function. All inquiries lead to the Trns•port products Site Manager and Field Manager mobile application currently supported by AASHTO. These two packages are the ones proposed for acquisition, transfer and modification under the proposed alternative.

Several additional applications were considered which seemed to address a portion of the business needs identified within Section 3. For each package, the system was reviewed focusing on several key areas, including mobile capability, contract administration, billing and payment, product quality, claims/dispute resolution, web functionality, and Oracle database compatibility. The conclusion is that no single off-the-shelf system provides the functionality to support more than three of these areas. Further, it appears most systems were designed for use in the private sector and are geared towards supporting the needs of the contractor, and not the project owner (i.e. the Department).

During the course of this study, the following packages were considered for evaluation to determine whether they provide the functionality necessary to fulfill the requirements of the construction program. These packages included:

- Gold Collection (Timberline)
- Manager 6 (Prolog)
- ePeg (Bear River Associates)
- PMIV (Integral Vision)

Section 6 - Project Management Plan

6.1 Project Manager Qualifications

The CMS project manager will be a full-time assignment and will have the skills and knowledge to lead the project through implementation. Specifically, the project manager will be an experienced information technology project manager possessing the following key qualifications:

- Understanding of the construction program's business objectives and their relation to the project's objectives
- Knowledgeable in construction business processes, procedures, and information technology
- Experienced in applying PMI standard processes and procedures in projects of similar size and scope
- Experienced in managing and administering State of California projects involving standard interactions with Department of General Services and Department of Finance.
- Skilled in communicating, both written and oral, on goals, objectives and status with management, stakeholders, and staff
- Skilled in resolving phase conflicts with stakeholders, vendors, and phase staff
- Knowledgeable in the Department of Transportation (Department) information technology project procurement and development methodologies
- Experienced at working with multiple vendors to accomplish information technology and business process change goals
- Knowledgeable in information technology project management and execution methodologies, using scheduling tools and information technology application development strategies

To mitigate project risk and ensure the Department has the necessary skills within the team to manage a large prime vendor; this role is proposed to be accomplished by a CMAS project management consultant under the direction of Department management.

6.2 Project Management Methodology

The CMS project will utilize project management methodologies (PMM) as found in the Department's information technology (IT) Project Management Manual to ensure compliance with the various control agency requirements. It contains information on the following areas:

- Project Execution Methodology
- Project Cycles
- Project Management Volume Organization
- Roles and Responsibilities for IT Projects
- Project Management Policies
 - Project Approval
 - Project Planning and Tracking

- Quality Assurance
- Configuration Management
- Risk Management
- Project Oversight
- Project Closeout
- Contract Management

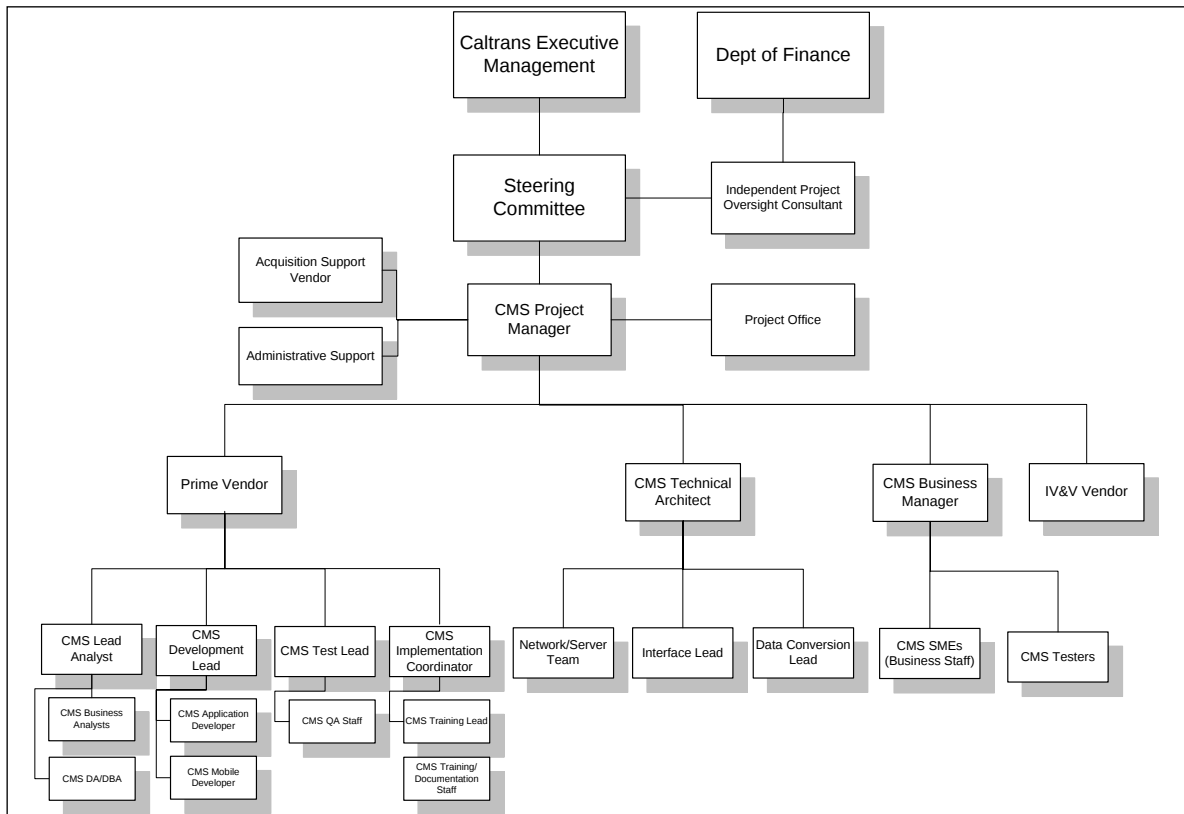
6.3 Project Organization

Table 6-1 contains the CMS project team makeup and Figure 6-2 contains the organization chart for the project. The project team will work closely with district and field office management and staff to ensure their staffing needs are met and to ensure adequate representation of both the district and field offices within the project team. Vendor staff will augment the project team to provide specific skills and expertise as identified within Table 6-1.

Table 6-1 Project Roles

Project Team Area	Prime Vendor/ Department Responsibility	Can be staffed by vendor?	State/CMS Classifications
Project Steering	Department	No	Various
Independent Project Oversight	Department	Yes– Required	CMS – IPO Category
Independent Verification and Validation	Department	Yes– Required	CMS – IV&V Category
CMS Project Manager	Department	Yes	CMS – PM Category
CMS Acquisition Support	Department	Yes	CMS – Acquisition Support Category
CMS Administrative Support	Department	No	Admin Asst./Student Asst.
CMS Business Manager	Department	No	Senior Transportation Engineer
Business Analysts	Prime		
Subject Matter Experts	Department	No	Various
CMS System Architect	Department	No	Senior Info. Systems Analyst
CMS Development Lead	Prime		
CMS Application Developers	Prime		
CMS Mobile Developers	Prime		
CMS Testing Lead	Prime		
CMS Testers	Department	No	Various
CMS DBA	Prime		
CMS Implementation Coord.	Prime		
CMS Training Lead	Prime		
CMS Trainers	Prime		
CMS Data Conversion Lead	Department	No	Senior Info. Systems Analyst
CMS Network/Server Staff	Department	No	Staff Info. Systems Analyst
CMS Interface Lead	Department	No	Senior Info. Systems Analyst

Figure 6-2 CMS Project Organization



6.4 Project Priorities

Listed below are priorities assigned by this project's stakeholders.

Table 6-2 Project Priorities

Project Variable	Stakeholder Ranking
Resources	Constrained
Scope	Accepted
Schedule	Improved

The resources for the CMS project are the least flexible. The Department has a limited number of business experts who can assist in the design, development, and implementation of CMS. The Department also has a limited number of technical resources that are knowledgeable about the legacy mainframe system to assist with interface and data conversion activities.

The project scope is somewhat flexible. The Department has divided the long-term vision of CMS into several projects in order to increase the chances of success by addressing user needs in manageable sections. Each project is designed to expand on the previous deliverables by adding measurable business benefits. CMS contains the functionality that is considered most necessary to be implemented first, but some of the functions could be installed at a later date (or even not at all) if necessary.

The project schedule is the most flexible. No “must finish by” dates are planned, and the project can be delayed for short terms without any major negative consequences. However, the project schedule is driven by the desire to improve business processes within the construction program. A delay in achieving the proposed improvements will expose the Department to the risks posed by the current antiquated system environment and will further delay the realization of business benefits known to be available through this project.

6.5 Project Plan

6.5.1 Project Scope

The CMS project will consist of those tasks and activities that are required to achieve the following:

- 1) Implement CMS (and convert CAS/CUC systems) to a web-based Oracle/Unix platform, which includes the following business processes:
 - a) *Contract Initiation*
 - b) *Contract Management*
 - c) *Progress Pay Estimates*
 - d) *Extra Work/Change Orders*
 - e) *Payment Processing (limited to payment initiation)*
 - f) *Claims and Arbitration Management*
 - g) *Contractor Information Input Process*
 - h) *Workflow Processing*
 - i) *System Alert and Notification*
 - j) *Reporting*
 - k) *Electronic Interfaces*
 - l) *User Management*
- 2) Replace manual documentation processes with automated systems, which include:
 - a) *Mobile electronic daily diary system*
 - b) *Electronic Record Search and Retrieval*
- 3) Contract Funding Status - (Note: While CMS will not provide financial management or payment functions consistent with the strategy set forth in the Integration Study, it will produce payment triggers and will require an up-to-date read-only view of project financial status for the RE to effectively manage the project through CMS)
- 4) Product Quality, including
 - a) *Product and Material Testing/Certification*
 - b) *Material Testing Schedule*
 - c) *Test Results*
 - d) *QC/QA*

- 5) Dispute Resolution, including:
 a) *Dispute Review Board*
 b) *Dispute Resolution*

Out of Scope Functions

The CMS project will not develop functions or processes for:

1) Financial Management

(Note: While CMS will not provide financial management or payment functions consistent with the strategy set forth in the Integration Study, it will produce payment triggers and will require an up-to-date read-only view of project financial status for the RE to effectively manage the project through CMS)

2) Resource Management

3) Cost/Scope/Schedule Management

4) Project Design Processes

5) Bid Management

6) As-Builts

7) Support (Direct), including:

- a) *Safety Reviews*
 b) *Construction Zone Enhanced Enforcement (COZEEP)*

8) Document Scanning and Imaging

6.5.2 Project Assumptions

Major assumptions include:

- Funding for the CMS project is acquired for the time period specified in the FSR
- The Department makes all necessary staff available to work on the project
- The network/server installation will be performed into existing network infrastructure, including a redundant site within the Department.
- District office staff can be utilized as subject matter experts within the project team
- The Department standard project management methodology (PMM) will be utilized
- The Department can leverage the existing version of federally supported AASHTO software, which is already implemented in other states and is compliant with federal regulations, and then modify it to meet California's specific needs and to adhere to Department technical standards.

6.5.3 Project Phasing

The CMS project will be implemented in two distinct phases to reduce the overall risk of the project. Each phase of the project can be implemented into production as its own distinct implementation. Phase 1 of the project will result in a web-based application, eliminating the need for duplicative systems in district offices, creating a web site for entry of data and project approvals by federal and contract partners, and provide a central point of contract management

for internal Department staff. At the conclusion of Phase 1, CAS and CUC will have been converted into CMS and will no longer be used by the Department, and much of paperwork which flows between the Department and the contractor, or its federal and local funding partners, will have been automated through web-based forms.

Following the implementation of Phase 1, the system will be augmented with a mobile application during Phase 2 which provides the RE with a mobile application to directly capture and track project data while away from the office. With the Phase 2 mobile application, the Department will be able to automate the voluminous daily diary files with a direct data capture capability and eliminate much of the paperwork the RE currently creates, sends, and stores in the district offices.

Within the execution of the project, the project is structured to use the following major phases consistent with the Department's standard project management methodology.

Table 6-3 Project Deliverables

Phase	Phase Deliverable
1) Procurement	• IT Procurement Plan • Procurement Requirements • RFP Document • Proposal Evaluation Criteria • Proposal Recommendation • Final Proposal Selection • Final Prime Contract Document • Procurement of CMAS contract services
2) Project Initiation	• Project Charter • Detailed project plan, including: - Scope statement - Scope management plan - Work breakdown structure - Project schedule - Schedule management plan - Project role and responsibility assignments - Staff management plan - Detailed cost estimates - Cost management plan - Benefit tracking plan - Quality management plan - Communications management plan - Risk management plan - Configuration management plan • Kick-off meeting • Setup of Standard Project Files • Physical Project Location (Facility) • Project Location Setup (e-mail, desks, file storage, PCs, phone, etc.)
3) Base CMS Analysis	• Detailed business requirements documents for the CMS

Phase	Phase Deliverable
	- Detailed technical design specifications for the web-based CMS application - Detailed business design specifications for the web-based CMS application
4) Base CMS Design	- Design documents for web-based CMS application - Prototype of web-based CMS application (proof-of-concept) - Project testing strategy - Project training plan - Updated and refined project plan
5) Base CMS Construction	- Unit tested Web-based CMS application - Web-Based CMS application - Updated and refined project plan
6) Base CMS Pilot / Test / Training Prep	- Completed pilot - Successful completion of integration testing - Successful completion of system testing - Successful completion of performance testing - Training curriculum document - Production Support Process document - Updated and refined project plan
7) Base CMS Implementation Prep/ Implementation	- Procured hardware - Installed/Tested Hardware/Software infrastructure - Web-based CMS application installed in production - Successful completion of UAT - Converted CAS/CUC data into CMS - Completion of Base CMS application implementation - Completion of user and customer training - Implemented Production Support Process (Help Desk, technical supp) - Implemented CMS Service Level Agreement (SLA) - Updated and refined project plan
8) Mobile Application Analysis	Detailed business requirements documents for the CMS Mobile Application
9) Mobile Application Design	- Detailed technical design specifications for the CMS Mobile Application - Detailed business design specifications for the CMS Mobile Application - Design documents for the CMS Mobile Application - Prototype CMS Mobile Application (proof-of-concept) - Mobile Application testing strategy - Mobile Application training plan - Updated and refined project plan

Phase	Phase Deliverable
10) Mobile Application Construction	• Unit tested CMS Mobile Application • CMS Mobile Application test scripts • Updated and refined project plan
11) Mobile Application Pilot / Test / Training Prep	• Completed CMS Mobile Application pilot • Successful completion of integration testing • Successful completion of system testing • Successful completion of performance testing • Training curriculum • Updated and refined project plan
12) Mobile Application Implementation	• Procured mobile device hardware • CMS Mobile Application installed in production • Successful completion of UAT • Completion of CMS Mobile Application pilot implementation • Completion of CMS Mobile Application implementation • Completion of user and customer training • Updated and refined project plan
13) Project Closeout	• Lessons Learned Document • Shut-down of CAS/CUC Legacy System • Closed Project Facility • PIER

6.5.4 Roles and Responsibilities

Listed in Table 6-4 are descriptions of the CMS project's roles and responsibilities.

Table 6-4 Project Roles and Responsibilities

Roles	Responsibilities
Department Executive Management	Executive Management will: • Review and adopt/reject steering committee recommendations
Steering Committee	The steering committee will consist of District, HQ, Construction Division, IT Executive staff and the project sponsor. The Steering Committee will: • Guide the overall effort towards the achievement of its objectives • Review and adopt / reject project manager recommendations • Review progress and resolve outstanding issues

Roles	Responsibilities
Department of Finance	A representative of the Department of Finance will: • Review IPOR documents provide by the project IPOC resource • Review any project BCP/SPR documents • Review the project PIER at project closeout • Assist in ensuring project funding issues are identified to Department and Project Management
Independent Project Oversight Consultant	The IPOC will: • Perform period reviews of project documents. • Review IV&V and Project Management deliverables • Monitor, review, and advise the project team on all risk related activities • Develop and provide independent project oversight reports (IPOR) to the Department of Finance • Review and adjust IPOR reports and feedback with Department and Project Management • Provide project guidance to CMS Project Manager and Department Management
CMS Project Manager	The project manager will: • Understand construction program business objectives and their relationship to the project • Plan the project, resource that plan, monitor and report progress versus plan to the steering committee as appropriate • Resolve phase problems and conflicts • Manage all State and vendor project tasks throughout the projects • Maintain all Project Management files • Manage and track all project risk management activities. • Manage the development and implementation of a solution to address the project's and associated program objectives

Roles	Responsibilities
Project Manager (cont'd)	• Act as the program's spokesman responsible for communicating program strategy, benefits, direction, status, and recommendations to the steering committee, and other stakeholders Ensure quality control and quality assurance are performed in accordance with the quality plan • Ensure all problems, issues and changes are recorded, maintained, and tracked in the program's tracking database • Ensure all correspondence going from or coming into the project are recorded in the program's correspondence database
Acquisition Support Vendor	The acquisition support vendor will provide: • RFP Development support • Bid evaluation criteria • Bid evaluation facilitation • Contract Negotiation assistance • Assist Hardware/Software Acquisition
Administrative Support	Administrative support will support the Project Manager with: • Project administration support • Assist with collection, tracking and reporting on all project management processes • Maintain issue tracking database • Maintain risk tracking documents • Assist with document publication/circulation • Maintain Project Management files
Project Office	The project office will provide: • Project Management support and guidance • IT methodology support
IV & V Consultant	Provide to the steering committee an independent assessment on the progress of each project including a risk management database and monitoring of risks, issues and problems that may impact the achievement of program and/or project objectives. Activities

Roles	Responsibilities
IV & V Consultant, (cont'd)	include: • Periodic progress reports • Special assessment reports on a facet(s) of the effort • Establish and maintain a database to track requirements from the package selection process through the final delivered product
Prime Vendor/Team	The business team will be responsible for: • Requirements Analysis • System Design • Application Development • Test Planning • Unit Test Scripts/Test Results • System Test Scripts/Results • Performance Test Scripts/Results • System Documentation • Application implementation • Training plans • Development of training curriculum • User Training Sessions
Business Manager/Team	The business team will be responsible for: • Project location/facility • Business review of prime vendor deliverables • Providing Subject Matter Experts to support requirements, design, and development • Testers for System Testing • User Acceptance Test Plan • User Acceptance Testing • Implementation support
Technical Architect/Team	The technical team will be responsible for: • Technical review of prime vendor deliverables • Adherence to departmental technical standards • Design and development of data conversion • Design and development of system interfaces • Support all testing activities • Hardware/Software installation

6.5.5 Project Schedule

CMS Project Activity Milestones

Table 6-5 Project Milestones

Activity	Milestone	Milestone Date
1) Project Initiation	• Project Approval to Proceed	8/1/2005
	• Release “support” vendor RFPs – PM/Procurement, IV&V and Oversight	4/1/2006
	• Select support vendors	6/1/2006
	• Support vendor approvals	9/1/2006
	• Release development RFP	12/1/2006
	• Select development vendor	3/1/2007
	• Development vendor approval	7/15/2007
2) Project Startup	• Project location/facility setup	8/15/2007
	• Detailed project plan	9/15/2007
	• Transfer System Acquired	9/15/2007
3) Phase 1 (CMS Base) Analysis	• Detailed business requirements	11/1/2007
	• Detailed technical requirements	11/1/2007
4) Phase 1 Design	• Detailed technical and business design specifications	3/15/2008
	• Project testing strategy	5/1/2008
	• Project training plan	5/1/2008
5) Phase 1 Construction	• Construction complete	9/15/2008
	• Unit testing complete	10/15/2008
6) Phase 1 Testing / Training Prep	• Pilot complete	1/1/2009
	• Successful completion of integration, and system testing	4/01/2009
	• Training curriculum document	2/15/2009
7) Phase 1 Implementation	• Hardware/Software installed	2/15/2009
	• User Acceptance	3/15/2009
	• Completion of Perf. Test	4/1/2009
	• Phase 1 installed in production	5/1/2009
	• Completion of user, customer, and production support training	8/1/2009
8) Phase 2 (Mobile) Analysis	• Detailed business requirements	5/1/2009
9) Phase 2 Design	• Detailed technical and business design specifications	7/15/2009
	• Project testing strategy	9/1/2009
	• Project training plan	9/1/2009
10) Phase 2 Construction	• Construction complete	11/1/2009
	• Unit testing complete	12/15/2010

Activity	Milestone	Milestone Date
11) Phase 2 Testing / Training Prep	• Successful completion of integration system, and performance testing	2/1/2010
	• Training curriculum document	2/1/2010
12) Phase 2 Implementation	• Hardware/Software acquired	1/1/2010
	• User Acceptance	2/15/2010
	• Phase 2 installed in production	3/1/2010
	• Completion of user, customer, and production support training	5/1/2010
13) Project Closeout	• Shutdown legacy system	12/1/2009
	• Shutdown project site	7/1/2010
	• Publish Project PIER	6/1/2011

6.6 Project Monitoring

The process to be used for tracking and reporting on the status of project and phase deliverables, phase schedule and phase budget is defined in the IT Project Management Policy CT.PM-5-Project Tracking. This policy states: *“Each information technology project management team will track the status and monitor the progress of defined project activities against the Project Management Plan and will document variance in terms of scope, schedule, and cost, as required, for all information technology projects within Caltrans.”*

6.7 Project Quality

The process to be used for assuring phase results will meet business and technical objectives and requirements, as well as applicable State and departmental standards as defined in the IT Project Management Policy CT.PM-7-Quality Assurance. This policy states: *“Caltrans will maintain processes and organizational entities to ensure that quality assurance is performed for information technology products that will include meeting stated business requirements and technology standards.”*

6.8 Change Management

The project’s configuration management procedure to be followed is defined in the IT Project Management Policy CT.PM-8-Configuration Management. This policy states *“Configuration management shall be performed on all information technology projects in accordance with established Department configuration management procedures. These procedures must ensure that: controlled and stable baselines are established for planning, managing, and building the system; the integrity of the system’s configuration is controlled over time; and the status and content of the baselines are known.”*

6.9 Authorization Required



Approval of the FSR is required internally from the Department, and externally from the Business, Transportation and Housing Agency and the Department of Finance. Approval of the RFP is required externally from the Department of General Services.

Section 7 - Risk Management Plan

This section describes the risk management plans and activities that the Department of Transportation (Department) will use to assist in ensuring the CMS is a successful project. To mitigate the risks involved with implementing the CMS project, the Department will implement a formal risk management plan and process consistent with Department project management standards. The plan uses the following four concepts:

- Risk Identification
- Risk Analysis and Quantification
- Risk Mitigation Planning
- Risk Response

The processes and procedures to be used are defined in the Department's information technology (IT) Project Management Policy CT.PM-9-Risk Management. This policy states: *"Risks associated with each Caltrans Information Technology project will be identified, analyzed, and prioritized. Identified risks will be controlled through the processes of project planning and monitoring. Risk identification and management will be integrated components of project management and will be continually assessed and analyzed during the life of the project."* Using industry proven IT methodologies throughout the life of this effort will reduce the risks associated with this project.

As described in Section 6, the Department project manager will act as the risk manager for this project. This is acceptable because of the relatively small size of the project. The independent project oversight consultant (IPOC) will provide oversight and review of the risk management function in addition to their other project oversight duties.

Risk management will involve all project participants and will be conducted throughout the project life cycle. Risk management began with the development of the conceptual solution that will be procured and implemented as a result of this project. During the course of this study, the FSR team identified several key risk areas. These risks have been documented within this section, and where appropriate, the actions taken to date to either mitigate or plan contingencies have been included. After the project kickoff occurs, there will be periodic risk management sessions throughout the project involving the project participants, and under the direction of the project manager. Based on the results of this session, additional project activities may be identified for the project plan. If a risk event occurs as the project unfolds, the project manager may convene one or more special risk management sessions.

Every monthly progress report will include reference to the specific risks relevant to the period. If new risks are identified between monthly progress reports, the project manager will decide whether or not consideration of the risk can be safely deferred until the next report. If not, the project manager will convene a special risk management session to specifically address the new risk.

To minimize the risks associated with this project, the Department will:

- Use standard Department of Transportation hardware (proven track record).



- Prepare monthly progress reports. These will be reviewed by the project sponsor and by the IT Project Management Division.
- Modify and enhance existing application software, where applicable, and ensure the software will meet unique to Department requirements, adjusting all settings, codes, tables, switches, and others, to be Department specific.
- Implement Construction Management applications using a prime vendor with experience implementing similar applications in other states.
- Retain the existing systems used to support the current process until the new CMS system has passed acceptance testing. This will allow a roll-back option should it be needed due to unforeseen problems with the project.
- Perform an initial detail requirements phase in cooperation with the selected vendor prior to proceeding with any system development
- Perform a pilot with volunteer construction contractors and resident engineers before full implementation. This will help expose any issues or problems.
- Include independent project oversight and independent verification and validation contractors to assist the Department in overseeing and assuring the project throughout each phase of the project.
- Hire CMAS contractors for specific Department responsibilities within the project to ensure proper large project experience is present in the team to represent the Department in working with the prime vendor.
- Work with the Department's Project Office to obtain an independent perspective on the project management and risk management activities of the project.

7.1 Risk Management Worksheet

During the course of this study, the project team initiated risk management tasks and identified a series of risks associated with the CMS project. The result of these risks identification activities and the defined risk measures are included in the list of risks below.

Table 7-1 Risk Management Worksheet

ID	Risk Category / Event	Probability (0=Low; 10=High)	Affected Project Area/Element	Preventive Measures (P) & Contingency Measures (C)
1	Project is not approved for implementation	5	Budget	None possible
2	Lose project funding completely	3	Budget	None possible
3	Loss of project funding in FY 06-07	5	Budget	None possible Postpone project implementation until FY 07-08 and write Special Project Report (SPR) to postpone project start.
4	The solution fails to realize the expected benefits	2	Budget	Include benefit assessment tasks within the project manager responsibilities. During the project, include benefit update sessions at each key milestone identify changes and/or additions to the potential solution benefits.
5	The project experiences cost overruns	2	Budget	Implement rigorous scope control through the review of project financials on a monthly basis
6	Procurement of a prime vendor is delayed	3	Schedule	Include an Acquisition Specialist within the project team to work with DGS and complete all necessary procurement documents.
7	Late Project Delivery	3	Schedule	Utilize detailed planning with rigorous scope control under the direction of a PM with experience managing similar projects.

ID	Risk Category / Event	Probability (0=Low; 10=High)	Affected Project Area/Element	Preventive Measures (P) & Contingency Measures (C)
8	The IFMS, or other initiatives cause changes in interface requirements for CMS.	1	Scope	Specify solution requirements to encompass messaging and interface capabilities identify in the Integration Study Incorporate formal Change Control processes to assess, scope, and budget for additional changes after project startup.
9	Regulation change in mid-project	3	Scope	Incorporate formal Change Control processes to assess, scope, and budget for additional changes after project startup.
10	Caltrans cannot commit a qualified internal Project Manager full-time to manage a project of this magnitude	3	Resources	Hire outside PM with experience managing projects of similar scope and magnitude
11	Contractor's resist adoption of web entry	3	Resources	Create Communication plan to "market" the solution to the contractor community
12	Caltrans staff cannot support production system	1	Resources	Include staff technical training for production support staff to ensure adequate skills are provided.
13	Lose key IT staff	4	Resources	Cross training, documentation of staff efforts Assign alternate staff. Keep alternate staff briefed about efforts.
14	Field staff are resistant to the new application/mobile devices	1	Resources	Incorporate an aggressive Change Management campaign to "market" the solution to the RE community. Involve RE and District staff in key solution decisions to give them a voice and ownership in the solution.

ID	Risk Category / Event	Probability (0=Low; 10=High)	Affected Project Area/Element	Preventive Measures (P) & Contingency Measures (C)
				Involve Districts in the Steering Committee.
15	A system component fails	3	Technical	Where possible, provide redundancy in each layer of the system architecture to remove a single point of failure
16	The entire system fails (either through failure or disaster)	3	Technical	Provide a backup redundant system to bring the system
17	Hacker or Virus breaches the system	3	Technical	Ensure proper monitoring and tracking systems and procedures are in place (already in place within departmental infrastructure) Provide backup system in the event the breach occurs and disables the system.
18	Asset tracking of mobile computing devices (restate as risk)	3	Technical	Include automated tag/tracking in hardware requirements. Provide a small, ready inventory of mobile computing devices in the project budget to replace lost or destroyed mobile devices
19	Damage to mobile computing devices at a construction site	3	Technical	Provide a small, ready inventory of mobile computing devices in the project budget to quickly replace lost or destroyed mobile devices
20	Unanticipated system operational problems	4	Technical	Develop project implementation in small testable phases Maintain operational readiness of existing systems and roll back to original bidding process since original process is largely manual paper based with minor automation support.

ID	Risk Category / Event	Probability (0=Low; 10=High)	Affected Project Area/Element	Preventive Measures (P) & Contingency Measures (C)
21	Increased Data Processing requirements overtax system capabilities	1	Technical	Specify and purchase hardware with the capability to increase processor capacity, disk, and throughput to ensure each component is expandable. Test system under simulated load prior to going into production
22	WAN is unavailable	1	Technical	Adhere to Department network operations practices to minimize risk
23	Subsystems to be integrated and/or interfaced with CMS are not compatible.	1	Technical	Specify and adhere to strict XML interface messaging standards consistent with the specification of the Integration Study Specify adherence to departmental technical standards for any solution to ensure compatibility

The Risk Management Worksheet will be updated for each monthly status report throughout the life of the project to document any new risks, or to remove risks that no longer apply.

7.2 Assessment, Identification, Analysis and Quantification, Prioritization

Risk assessment involves evaluating risks, as well as risk interactions, to assess the range of possible impacts on the project. It focuses on determining which risk events warrant a response. Each risk will be classified and prioritized using a scale of high, medium or low indicating the probability of occurrence. The project manager, risk manager, and project sponsor will jointly decide at what level of risk they will manage. For example, they may agree to immediately respond to risks that have a high probability of occurring. Each risk will also have an impact rating (high, medium, and low) as well as a designation of what part of the project it affects.

7.3 Risk Response

Risk response defines the project team's response to threats and determines how to respond to a recognized risk at a level that merits response. The project manager and project team propose the risk response to the project sponsor, project oversight, and the project steering committee. This response can consist of one of the following three approaches:

- Avoidance. The project team can control this element. The team cannot eliminate all risk, but specific risk events can often be eliminated.

- Mitigation. The project team can control mitigation. Mitigation reduces the expected impact of a risk by reducing the probability of occurrence. An example is using a proven technology to lessen the probability that the product will not work.
- Acceptance. The project team has no control over this risk and therefore accepts the consequences. However, the team proactively develops and uses the contingency plan should the risk occur.

The deliverables of the risk management activities are the risk management plan and the risk contingency plan.

- Risk Management Plan - The project manager, the risk manager, and the various team members are responsible for documenting and maintaining the procedures used to manage risk throughout the project. The project manager and risk manager will present this plan to the executive business sponsor and project steering committee for review and acceptance.
- Risk Contingency Plan - This plan is part of the risk management plan and maintained by the project manager, risk manager, and various team members. It predefines action steps to be taken if an identified risk event should occur.

7.4 Risk Tracking and Control

To prevent failure on the project, the project manager, risk manager, and project sponsor will monitor risk throughout the project. In addition, an oversight consultant will assist in monitoring the project for risks. The tools used to monitor risk include project management software to identify potentially impacted project activities situated on the critical path, a risk management plan, and risk management worksheets.

Risk control executes the risk management plan to respond to the risk events throughout the duration of the project. As changes occur, identification, quantification and response are repeated. Control and iteration are important. The project manager, risk manager, and project sponsor control the risks. Some risk control techniques to be used are as follows:

- Corrective action. This action uses the risk management plan as a guide to performing the planned risk response.
- Update the Risk Management Plan. As the project changes, anticipated risks occur or fail to occur. As risk event effects are evaluated, the risk management plan will be updated.

Risk will be tracked and controlled using the risk management methodologies provided in Section 4.10 of the IT Project Management Methodology Manual. The methodologies document identification, possible preventive or contingency measures, and status.



Section 8 - Economic Analysis

Figure 8-1 Existing System Cost

EXISTING SYSTEM/BASELINE COST WORKSHEET

All costs to be shown in whole (unrounded) dollars.

Date Prepared: 09/28/2005

Department of Transportation
Construction Management System

	FY 2006/07		FY 2007/08		FY 2008/09		FY 2009/10		FY 2010/11		FY 2011/12		SUBTOTAL	
	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts
Continuing Information														
Technology Costs														
Staff (salaries & benefits)	8.5	738,520	8.5	738,520	8.5	738,520	8.5	738,520	8.5	738,520	8.5	738,520	51.0	4,431,120
Hardware Lease/Maintenance		0		0		0		0		0		0		0
Software Maintenance/Licenses		0		0		0		0		0		0		0
Contract Services		175,000		175,000		175,000		175,000		175,000		175,000		1,050,000
Data Center Services		584,462		584,462		584,462		584,462		584,462		584,462		3,506,772
Agency Facilities		0		0		0		0		0		0		0
Other		0		0		0		0		0		0		0
Total IT Costs	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	51.0	8,987,892
Continuing Program Costs:														
Staff	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	30036.0	2,434,656,816
Other		0		0		0		0		0		0		0
Total Program Costs	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	30036.0	2,434,656,816
TOTAL EXISTING SYSTEM COSTS	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	30087.0	2,443,644,708



Figure 8-2 Proposed Alternative

PROPOSED ALTERNATIVE: Modify Existing State Solution (from other Transportation Depts.)

Date Prepared: 09/28/2005

Department of Transportation
Construction Management System

All Costs Should be shown in whole (unrounded) dollars.

	FY 2006/07		FY 2007/08		FY 2008/09		FY 2009/10		FY 2010/11		FY 2011/12		SUBTOTAL	
	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts
One-Time IT Project Costs														
Staff (Salaries & Benefits)	3.0	202,500	5.8	643,242	9.9	936,808	3.1	271,258	0.0	0	0.0	0	21.8	2,053,808
Hardware Purchase		0		354,218		767,689		0		0		0		1,121,907
Software Purchase/License		0		239,344		0		0		0		0		239,344
Telecommunications		0		0		0		0		0		0		0
Contract Services														
Software Customization		0		3,396,557		7,936,186		2,384,122		0		0		13,716,865
Project Management/Procurement		556,416		334,656		290,304		120,960		0		0		1,302,336
Project Oversight		48,989		280,325		326,592		136,080		0		0		791,986
IV&V Services		43,546		491,098		580,608		241,920		0		0		1,357,172
Technical Training		0		0		50,000		0		0		0		50,000
TOTAL Contract Services		648,951		4,502,636		9,183,690		2,883,082		0		0		17,218,359
Data Center Services		0		60,000		60,000		20,000		0		0		140,000
Agency Facilities		0		0		0		0		0		0		0
Other		0		0		0		0		0		0		0
Total One-time IT Costs	3.0	851,451	5.8	5,799,440	9.9	10,948,187	3.1	3,174,340	0.0	0	0.0	0	21.8	20,773,418
Continuing IT Project Costs														
Staff (Salaries & Benefits)	0.0	0	0.0	0	0.0	0	8.5	679,000	8.5	679,000	8.5	679,000	25.5	2,037,026
Hardware Lease/Maintenance		0		0		70,844		253,487		253,487		253,487		831,305
Software Maintenance/Licenses		0		0		175,869		175,869		175,869		175,869		703,476
Telecommunications		0		0		0		0		0		0		0
Contract Services		0		0		0		125,000		250,000		250,000		625,000
Data Center Services		0		0		0		0		0		0		0
Agency Facilities		0		0		0		0		0		0		0
Other		0		0		0		0		0		0		0
Total Continuing IT Costs	0.0	0	0.0	0	0.0	246,713	8.5	1,233,356	8.5	1,358,356	8.5	1,358,356	25.5	4,196,781
Total Project Costs	3.0	851,451	5.8	5,799,440	9.9	11,194,900	11.6	4,407,696	8.5	1,358,356	8.5	1,358,356	47.3	24,970,199
Continuing Existing Costs														
Information Technology Staff	8.5	738,520	8.5	738,520	8.5	738,520	0.0	0	0.0	0	0.0	0	25.5	2,215,560
Other IT Costs		759,462		759,462		759,462		379,731		3,600		3,600		2,665,317
Total Continuing Existing IT Costs	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	0.0	379,731	0.0	3,600	0.0	3,600	25.5	4,880,877
Program Staff	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	30036.0	2,434,656,816
Other Program Costs		0		0		0		0		0		0		0
Total Continuing Existing Program Costs	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	30036.0	2,434,656,816
Total Continuing Existing Costs	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5006.0	406,155,867	5006.0	405,779,736	5006.0	405,779,736	30061.5	2,439,537,693
TOTAL ALTERNATIVE COSTS	5017.5	408,125,569	5020.3	413,073,558	5024.4	418,469,018	5017.6	410,563,563	5014.5	407,138,092	5014.5	407,138,092	30108.8	2,464,507,892
INCREASED REVENUES		0		0		0		0		0		0		0



Figure 8-3 Other Alternative Cost

ALTERNATIVE #1: Custom Development Effort

Date Prepared: 09/28/2005

Department of Transportation
Construction Management System

All Costs Should be shown in whole (unrounded) dollars.

	FY 2006/07		FY 2007/08		FY 2008/09		FY 2009/10		FY 2010/11		FY 2011/12		SUBTOTAL	
	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts
One-Time IT Project Costs														
Staff (Salaries & Benefits)	3.0	202,500	5.8	643,242	9.9	936,808	3.1	271,258	0.0	0	0.0	0	21.8	2,053,808
Hardware Purchase		0		354,218		767,689		0		0		0		1,121,907
Software Purchase/License		0		79,344		0		0		0		0		79,344
Telecommunications		0		0		0		0		0		0		0
Contract Services														
Procurement/RFP Specialist		250,000												250,000
Software Customization		0		4,585,352		10,713,851		3,218,565		0		0		18,517,768
Project Management		751,162		451,786		391,910		163,296		0		0		1,758,154
Project Oversight		66,135		378,439		440,899		183,708		0		0		1,069,181
IV&V Services		58,787		662,982		783,821		326,592		0		0		1,832,182
Other Contract Services		0		0		50,000		0		0		0		50,000
TOTAL Contract Services		876,084		6,078,559		12,380,482		3,892,161		0		0		23,227,285
Data Center Services		0		60,000		60,000		20,000		0		0		140,000
Agency Facilities		0		0		0		0		0		0		0
Other		0		0		0		0		0		0		0
Total One-time IT Costs	3.0	1,078,584	5.8	7,215,363	9.9	14,144,979	3.1	4,183,419	0.0	0	0.0	0	21.8	26,622,344
Continuing IT Project Costs														
Staff (Salaries & Benefits)	0.0	0	0.0	0	0.0	0	8.5	679,000	8.5	679,000	8.5	679,000	25.5	2,037,000
Hardware Lease/Maintenance		0		0		22,844		205,487		205,487		205,487		639,305
Software Maintenance/Licenses		0		0		15,869		15,869		15,869		15,869		63,476
Telecommunications		0		0		0		0		0		0		0
Contract Services		0		0		0		125,000		250,000		250,000		625,000
Data Center Services		0		0		0		0		0		0		0
Agency Facilities		0		0		0		0		0		0		0
Other		0		0		0		0		0		0		0
Total Continuing IT Costs	0.0	0	0.0	0	0.0	38,713	8.5	1,025,356	8.5	1,150,356	8.5	1,150,356	25.5	3,364,781
Total Project Costs	3.0	1,078,584	5.8	7,215,363	9.9	14,183,692	11.6	5,208,775	8.5	1,150,356	8.5	1,150,356	47.3	29,987,125
Continuing Existing Costs														
Information Technology Staff	8.5	738,520	8.5	738,520	8.5	738,520	0.0	0	0.0	0	0.0	0	25.5	2,215,560
Other IT Costs		759,462		759,462		759,462		379,731		3,600		3,600		2,665,317
Total Continuing Existing IT Costs	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	0.0	379,731	0.0	3,600	0.0	3,600	25.5	4,880,877
Program Staff	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	30036.0	2,434,656,816
Other Program Costs		0		0		0		0		0		0		0
Total Continuing Existing Program Costs	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	30036.0	2,434,656,816
Total Continuing Existing Costs	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5006.0	406,155,867	5006.0	405,779,736	5006.0	405,779,736	30061.5	2,439,537,693
TOTAL ALTERNATIVE COSTS	5017.5	408,352,702	5020.3	414,489,481	5024.4	421,457,810	5017.6	411,364,642	5014.5	406,930,092	5014.5	406,930,092	30108.8	2,469,524,818
INCREASED REVENUES		0		0		0		0		0		0		0

Figure 8-4 Economic Analysis Summary

ECONOMIC ANALYSIS SUMMARY

Date Prepared: 09/28/2005

Department of Transportation
Construction Management System

All costs to be shown in whole (unrounded) dollars.

	FY 2006/07		FY 2007/08		FY 2008/09		FY 2009/10		FY 2010/11		FY 2011/12		SUBTOTAL	
	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts
EXISTING SYSTEM														
Total IT Costs	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	51.0	8,987,892
Total Program Costs	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	5006.0	405,776,136	30036.0	2,434,656,816
Total Existing System Costs	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	30087.0	2,443,644,708
PROPOSED ALTERNATIVE														
Modify Existing State Solution (from other Transportation Depts.)														
Total Project Costs	3.0	851,451	5.8	5,799,440	9.9	11,194,900	11.6	4,407,696	8.5	1,358,356	8.5	1,358,356	47.3	24,970,199
Total Cont. Exist. Costs	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5006.0	406,155,867	5006.0	405,779,736	5006.0	405,779,736	30061.5	2,439,537,693
Total Alternative Costs	5017.5	408,125,569	5020.3	413,073,558	5024.4	418,469,018	5017.6	410,563,563	5014.5	407,138,092	5014.5	407,138,092	30108.8	2,464,507,892
COST SAVINGS/AVOIDANCES	(3.0)	(851,451)	(5.8)	(5,799,440)	(9.9)	(11,194,900)	(3.1)	(3,289,445)	0.0	136,026	0.0	136,026	(21.8)	(20,863,184)
Increased Revenues		0		0		0		0		0		0		0
Net (Cost) or Benefit	(3.0)	(851,451)	(5.8)	(5,799,440)	(9.9)	(11,194,900)	(3.1)	(3,289,445)	0.0	136,026	0.0	136,026	(21.8)	(20,863,184)
Cum. Net (Cost) or Benefit	(3.0)	(851,451)	(8.8)	(6,650,891)	(18.6)	(17,845,791)	(21.8)	(21,135,236)	(21.8)	(20,999,210)	(21.8)	(20,863,184)		
ALTERNATIVE #1														
Custom Development Effort														
Total Project Costs	3.0	1,078,584	5.8	7,215,363	9.9	14,183,692	11.6	5,208,775	8.5	1,150,356	8.5	1,150,356	47.3	29,987,125
Total Cont. Exist. Costs	5014.5	407,274,118	5014.5	407,274,118	5014.5	407,274,118	5006.0	406,155,867	5006.0	405,779,736	5006.0	405,779,736	30061.5	2,439,537,693
Total Alternative Costs	5017.5	408,352,702	5020.3	414,489,481	5024.4	421,457,810	5017.6	411,364,642	5014.5	406,930,092	5014.5	406,930,092	30108.8	2,469,524,818
COST SAVINGS/AVOIDANCES	(3.0)	(1,078,584)	(5.8)	(7,215,363)	(9.9)	(14,183,692)	(3.1)	(4,090,524)	0.0	344,026	0.0	344,026	(21.8)	(25,880,110)
Increased Revenues		0		0		0		0		0		0		0
Net (Cost) or Benefit	(3.0)	(1,078,584)	(5.8)	(7,215,363)	(9.9)	(14,183,692)	(3.1)	(4,090,524)	0.0	344,026	0.0	344,026	(21.8)	(25,880,110)
Cum. Net (Cost) or Benefit	(3.0)	(1,078,584)	(8.8)	(8,293,946)	(18.6)	(22,477,638)	(21.8)	(26,568,162)	(21.8)	(26,224,136)	(21.8)	(25,880,110)		



Figure 8-5 Funding Plan

PROJECT FUNDING PLAN

Department of Transportation
Construction Management System

All Costs to be in whole (unrounded) dollars

Date Prepared: 09/28/2005

	FY 2006/07		FY 2007/08		FY 2008/09		FY 2009/10		FY 2010/11		FY 2011/12		SUBTOTALS	
	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts
TOTAL PROJECT COSTS	3.0	851,451	5.8	5,799,440	9.9	11,194,900	11.6	4,407,696	8.5	1,358,356	8.5	1,358,356	47.3	24,970,199
RESOURCES TO BE REDIRECTED														
Staff	0.0	0	0.0	0	0.0	0	8.5	738,520	8.5	738,520	8.5	738,520	25.5	2,215,560
Funds:														
Existing System		0		0		0		759,462		759,462		759,462		2,278,386
Other Fund Sources		0		0		0		0		0		0		0
TOTAL REDIRECTED RESOURCES	0.0	0	0.0	0	0.0	0	8.5	1,497,982	8.5	1,497,982	8.5	1,497,982	25.5	4,493,946
ADDITIONAL PROJECT FUNDING NEEDED														
One-Time Project Costs	3.0	851,451	5.8	5,799,440	9.9	10,948,187	3.1	3,174,340	0.0	0	0.0	0	21.8	20,773,418
Continuing Project Costs	0.0	0	0.0	0	0.0	246,713	8.5	1,233,356	8.5	1,358,356	8.5	1,358,356	25.5	4,196,781
TOTAL ADDITIONAL PROJECT FUNDS NEEDED BY FISCAL YEAR	3.0	851,451	5.8	5,799,440	9.9	11,194,900	3.1	2,909,714	0.0	(139,626)	0.0	(139,626)	21.8	20,476,253
TOTAL PROJECT FUNDING	3.0	851,451	5.8	5,799,440	9.9	11,194,900	11.6	4,407,696	8.5	1,358,356	8.5	1,358,356	47.3	24,970,199
Difference: Funding - Costs	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Total Estimated Cost Savings	0.0	0	0.0	0	0.0	0	0.0	6,730,753	0.0	12,433,720	0.0	18,750,049	0.0	37,914,522

Figure 8-6 Adjustments, Savings, and Revenues

ADJUSTMENTS, SAVINGS AND REVENUES WORKSHEET
(DOF Use Only)

Department of Transportation
Construction Management System

Date Prepared: 09/28/2005

Annual Project Adjustments	FY 2006/07		FY 2007/08		FY 2008/09		FY 2009/10		FY 2010/11		FY 2011/12		
	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	PYs	Amts	
One-time Costs													
Previous Year's Baseline	0.0	0	3.0	851,451	5.8	5,799,440	9.9	10,948,187	3.1	3,174,340	0.0	0	
(A) Annual Augmentation /(Reduction)	3.0	851,451	2.8	4,947,989	4.1	5,148,747	(6.8)	(7,773,847)	(3.1)	(3,174,340)	0.0	0	
(B) Total One-Time Budget Actions	3.0	851,451	5.8	5,799,440	9.9	10,948,187	3.1	3,174,340	0.0	0	0.0	0	
Continuing Costs													
Previous Year's Baseline	0.0	0	0.0	0	0.0	0	0.0	246,713	8.5	1,233,356	8.5	1,358,356	
(C) Annual Augmentation /(Reduction)	0.0	0	0.0	0	0.0	246,713	8.5	986,643	0.0	125,000	0.0	0	
(D) Total Continuing Budget Actions	0.0	0	0.0	0	0.0	246,713	8.5	1,233,356	8.5	1,358,356	8.5	1,358,356	
Total Annual Project Budget Augmentation /(Reduction) [A + C]	3.0	851,451	2.8	4,947,989	4.1	5,395,460	1.7	(6,787,204)	(3.1)	(3,049,340)	0.0	0	

[A, C] Excludes Redirected Resources

Total Additional Project Funds Needed [B + D]

Annual Savings/Revenue Adjustments

Cost Savings	0.0	0	0.0	0	0.0	0	0.0	6,730,753	0.0	12,433,720	0.0	18,750,049	
Increased Program Revenues		0		0		0		0		0		0	



Appendix A - Acronyms

AASHTO	American Association of State Highway Transportation Officials
AIMS	Agency Information Management Strategy
ARE	Assistant Resident Engineer
BPR	Business Process Review
CAS	Contract Administration System
CCO	Contract Change Order
CMAS	California Multiple Award Schedule
CMS	Construction Management System
CTI	Construction Transaction Input
CUC	Construction Unit Cost
DGS	Department of General Services
DOF	Department of Finance
EAI	Enterprise Application Integration
EAW	Economic Analysis Worksheet
FE	Final Estimate
FHWA	Federal Highway Administration
FIN	Federal Aid Ineligibility Notification
FSR	Feasibility Study Report
IFMS	Integration Financial Management System
IPOC	Independent Project Oversight Consultant
IPOR	Independent Project Oversight Report
ITPP	IT Procurement Plan
IV&V	Independent Verification and Validation
JMS	Java Messaging System
NOPC	Notice of Proposed Claim
ODBC	Open Database Connection
PETS	Project Estimate Tracking System
PFE	Proposed Final Estimate
PIER	Post Implementation Evaluation Report
PM	Project Manager
PMCS	Project Management Control System
PMI	Project Management Institute
PMM	Project Management Methodology
RE	Resident Engineer
SPR	Special Project Report
T3	Train the Trainer
WBT	Web Based Training
WCCP	Web Construction Contractor Payments
XML	Extensible Markup Language

Appendix B – Sample Calculation – Problem 3

<i>Pilot Project</i>	<i>Carquinez (manual)</i>	<i>San Mateo (automated)</i>
Contract Claims Submitted	\$23,563,819	\$21,654,485
Settlement Amount	\$6,766,796	\$7,338,208
Average Settlement Percentage	34.72%	33.89%
Total Amount Unsettled	\$14,170,750	\$0
Potential Settlement Amount (Average %)	\$4,920,154	\$0
Total Settled plus Unsettled Potential	\$8,113,929	\$7,338,208
Settled + Unsettled Potential %	34.43%	33.89%
Claim Research Costs	\$192,479	\$7,083
Research Costs as percent of claim	0.817%	0.033%
Research Savings as percentage of claims		0.784%