California AHMCT Program
University of California at Davis
California Department of Transportation

SUPPORT FOR BUSINESS CASE DEVELOPMENT FOR THE GPS-AUTOMATED TRAVEL DIARY (GPS-ATD) IN PREPARATION FOR THE 2010 STATEWIDE TRAVEL BEHAVIOR SURVEY – PHASE 1*

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16. Abstract

This report provides an overview of the effort to develop business case inputs that will allow Caltrans to quantify the benefits, costs, and impact of the GPS Automated Travel Diary (ATD) system. The ATD system is meant to provide an intuitive user interface to capture trip activity information (trip purpose, travel mode, etc.), with minimal user input and burden during travel surveys. Survey participants interact with their own personal ATD, and information is automatically captured and logged from the High-Sensitivity GPS (HSGPS) receiver. This data allows for subsequent identification of corridors, route lengths, and regional and inter-regional trips.

Results from the analytical support and editorial review of information in support of Caltrans' development of a Feasibility Study Report (FSR), Budget Change Concept (BCC) and Budget Change Proposal (BCP) documents will be summarized within this document.

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ABSTRACT

This report provides an overview of the effort to develop business case inputs that will allow Caltrans to quantify the benefits, costs, and impact of the GPS Automated Travel Diary (ATD) system. The ATD system is meant to provide an intuitive user interface to capture trip activity information (trip purpose, travel mode, etc.), with minimal user input and burden during travel surveys. Survey participants interact with their own personal ATD, and information is automatically captured and logged from the High-Sensitivity GPS (HSGPS) receiver. This data allows for subsequent identification of corridors, route lengths, and regional and inter-regional trips.

Results from the analytical support and editorial review of information in support of Caltrans' development of a Feasibility Study Report (FSR), Budget Change Concept (BCC) and Budget Change Proposal (BCP) documents will be summarized within this document.

EXECUTIVE SUMMARY

As part of the 2010 Statewide Travelers' Survey, it is fundamentally important that surveys can be carried on for a long duration while maintaining the survey data accuracy and integrity, and yet minimizing the burden on survey respondents. Therefore, a new method is needed for comprehensive, highly-automated and efficient data collection for individual travelers. The survey data are crucial for modeling trip generation, predicting the effects of transportation policy changes, and supporting the decision making process at the Federal, State, county and city level. In support of the need for additional research and deployment efforts of a suitable ATD solution, this project is providing analytical support and editorial review for the California State Department of Transportation (Caltrans) development of the Feasibility Study Report (FSR), Budget Change Concept (BCC) and the Budget Change Proposal (BCP).

As described in the proposal, "Support for Business Case Development for the GPS-Automated Travel Diary (GPS-ATD) in Preparation for the 2010 Statewide Travel Behavior Survey – Phase 1," six main tasks were specified to support the business case input development. This report will document the results to date from these tasks. Briefly, the six main tasks are:

1. *Review technical landscape and available commercial systems*

   The Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center will review the state of practice and provide a current assessment to support the discussion and presentation of real alternatives needed for BCP generation.

2. *Evaluate promising existing commercial systems*

   Based on the results of Task 1, AHMCT will procure and test the most promising alternative systems. This and task 1 will provide a strong basis for BCP Section "F: Analysis of All Feasible Alternatives"

3. *Support investigation of synergistic concepts*

   AHMCT will investigate synergistic concepts which will enhance the benefits of a ATD solution. This task will provide important input into BCP Section "C: State Level Considerations" and BCP Section "E: Justification"

4. *Support Caltrans' development of FSR*

   AHMCT will provide inputs for the "Business Case" and "Proposed Solution" sections of the FSR, as well as investigate impact on the IT infrastructure due to introduction of the ATD device.

5. *Support Caltrans' development of BCP*

AHMCT will assist in developing answers to the questions as required by the BCC and BCP narrative. AHMCT will provide inputs for BCP Section "C: State Level Considerations", "E: Justification", and "F: Analysis of All Feasible Alternatives".

6. *Summary reporting*

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DISCLAIMER/DISCLOSURE

The research reported herein was performed as part of the Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center, within the Department of Mechanical and Aeronautical Engineering at the University of California – Davis, and the Division of Research and Innovation at the California Department of Transportation. It is evolutionary and voluntary. It is a cooperative venture of local, State and Federal governments and universities.

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California, the Federal Highway Administration, or the University of California. This report does not constitute a standard, specification, or regulation.

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
AHMCT	Advanced Highway Maintenance and Construction Technology
Caltrans	California State Department of Transportation
COTS	Commercial-Off-the-Shelf
DRI	Division of Research and Innovation
GB	Gigabyte
GIS	Geographic Information System
GPS	Global Positioning System
GPS-ATD	GPS-Automated Travel Diary
HMI	Human-Machine Interface
HSGPS	High-Sensitivity GPS
MB	Megabyte
MEMS	Micro-Electro-Mechanical Systems
OBD	On-Board Diagnostics
PDA	Personal Digital Assistant
RAM	Random Access Memory
SDRAM	Synchronous Dynamic Random Access Memory
TSI	Transportation System Information
UCD	University of California-Davis
USB	Universal Serial Bus

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SECTION 1:
INTRODUCTION AND BACKGROUND

This section provides a brief introduction to traveler surveys, including a quick overview of previous methods of conducting surveys. Finally, a discussion and understanding of the context and need for the GPS-Automated Travel Diary (GPS-ATD) and the related business case inputs will be presented.

Traveler Surveys

There is a need for finer-grained understanding of traveler behavior than current data collection techniques allow for. Traditional cross-sectional survey methods are coarse and seek to provide traffic measurements for a single point of a road or intersection, thus providing traffic loading at a specific location over time. While this may support conclusions regarding a particular location, it does not address information on traveler behaviors such as trip purpose, trip frequency, schedule, route selection, and speeds used throughout the entire route. A system which can monitor current traveler location, time, speed, and intent is required. From these data, the following planning data can be predicted:

- developing travel demand models and forecasting future demand,
- predicting the number of trips generated by households as a function of demographics, socioeconomics, and location relative to employment and commercial center,
- estimating travel mode choice and traffic volumes on various roads,
- measuring and understanding trends in population behavior,
- assessing the impact of changes in transportation policy or the transportation system,
- predicting emissions from motor vehicles and input for air quality analysis,
- and calibrating regional models.

Household-level travel surveys collect three categories of data: household information, household member personal information, and travel activity information for a particular day or range of days. Travel diaries are the standard method used to capture participating household travel activity information. Travel diary methods may involve self-administered paper or computer input. However, gathering complete information from travelers has been problematic; the respondents may underreport, have poor recollection or have survey fatigue. This approach is not suited for long-term mobility pattern observations.

Previous surveys utilizing Global Positioning System (GPS) receivers have shown great potential. GPS-based surveys are more accurate and minimize the respondent burden. This approach captures route choice, path, and speed profile, information not feasible with other survey methods. GPS travel diaries used in the past may be classified into two types: *interactive* and *passive*. An *interactive* electronic travel diary requires the respondent to interact with the hand-held device to input survey information. This information includes marking trip start and end, trip purpose, cost of trip, and travel mode. A *passive* travel diary requires essentially no interaction from the users, merely turn on or off the device. Other travel information is collected through the traditional paper or voice surveys.

Replacing traditional self-administered paper travel diaries with interactive GPS-enabled travel diaries has shown significant reduction in respondent burden. Additionally, the information gathered via the GPS location data significantly enhances the value of the collected data. Therefore, a GPS-aided interactive travel diary could save both surveyors and respondents time and money both during the data collection effort and data analysis effort.

Previous research conducted by AHMCT[1] has suggested an architecture to integrate GPS data into an Automated Travel Diary (ATD). The research report recommends that the surveys be divided into two phases, as shown in Figure 1: Data Collection and Data Post-Processing. The ATD device that is in the end-user's possession would collect all necessary raw data, but leave further processing for subsequent Agency or contractor data post-processing and analysis. Such a split in data collection and processing responsibilities would minimize the cost, weight, complexity, and power consumption of the end-user's device. Further flexibility would be gained since researchers and analysts may then process and re-process the raw data with various new criteria, methods, and other additional updated information during subsequent post-processing phases.

[1] Development of Vehicular and Personal Longitudinal Travel Diary Systems Using GPS and New Technology, December 31, 2006, Report No. F/CA/IR200645, UCD-ARR-06-12-31-01

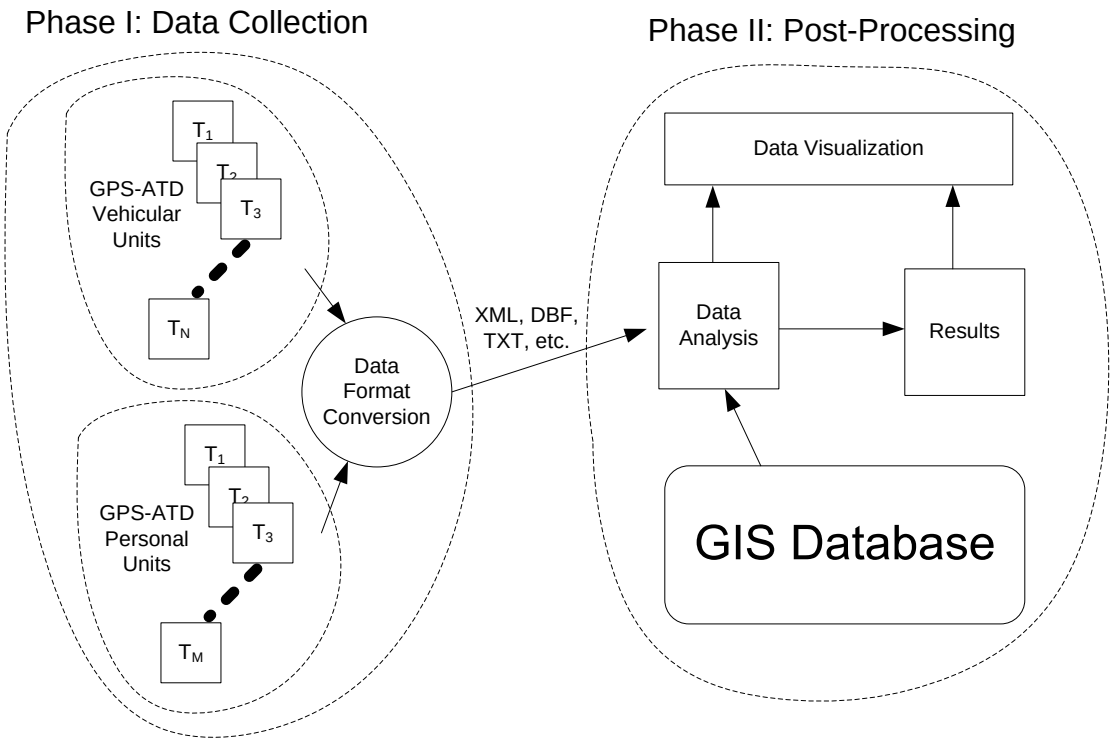

Figure 1: Data Collection and Post-Processing Scenario

SECTION 2:
REVIEW OF TECHNICAL LANDSCAPE AND AVAILABLE COMMERCIAL SYSTEMS

Recent technological developments and improvements in the Global Positioning System (GPS), low-cost small Micro-Electro-Mechanical Systems (MEMS) inertial sensors, low-power embedded computers, high-capacity storage devices, wireless communications, and high-speed Internet have converged to make a portable and low-cost data collection system a feasible reality. An overview of some of the devices and approaches are presented in the following tables.

These devices may be classified into three categories: GPS data logger, PDA with built-in GPS, and Personal Navigation Device (PND). Recently, GPS data loggers were developed for geo-tagging digital photos. These small GPS data loggers are battery powered and log position from their GPS receiver when ever the are turned on. Typically, the storage data are downloaded through USB connection to a computer. The user may configure the log frequency and data type using proprietary software. Their cost, run-time, and storage capacity are constantly improving with other technology advancements in battery, flash storage, and embedded GPS receiver. In addition, the decrease in size and power usage of GPS receivers makes portable PND possible. A few PDA manufacturers have started to integrate a GPS receiver into PDA to support navigation applications. With the addition of AHMCT's GPS-ATD software and workflow, these GPS enabled-PDA can be used as a GPS-ATD.

Table 1: Comparison of GPS-ATD and commercially-available GPS-enabled devices

	Passive GPS Logger	PDA with GPS	GPS-ATD
			
Description	Passive GPS logger: AGL3080, RBT-2300, RGM-3800, GiSTEQ	PDA with GPS: Airis T610 or T620, Pharos GPS 535, Asus MyPal A696	GPS-ATD (Automated Travel Diary)
Storage size	~ 400,000 to 1.3 million points 100 to 250 hrs @ 1Hz	Up to 2 gigabyte (GB) with SD card	Built-in 256 MB
Run-Time	8 hrs to 22 hrs	4 to 6 hrs (1200 mAh battery)	~ 11 hrs (1800mAh battery)
Data security	None	None Data encryption may be an option	Yes (only authorized personnel can download data)
Data integrity	None (Anyone can modify the data easily)	None (Anyone can modify the data easily) Data encryption may be an option	Yes (Nobody can modify the data)
Size	9.0 x 4.6 x 2.3 cm 7.0 x 3.7 x 2.4 cm	11.5 x 7.2 x 1.8 cm 11.7 x 7.1 x 1.6 cm	11.7 x 6.6 x 2.1 cm
Weight	Smallest: ~50 g (2.0 oz)	Medium: 165 g to 170 g (5.8 to 6.0 oz)	Medium: 142 g (5.0 oz)
User Interface for Data input	None	Yes	Yes
Strong sunlight readability	N/A	Good	Best
GPS chipset performance	Good to Best (SiRF III, MTK, or NEMERIX)	Best (SiRF III)	Best (SiRF III)
Cost	Lowest ($55 to $120)	$199 to $380	~$500 @ QTY=1000 (estimate)
Future integration to OBD-II	None	Yes, with Bluetooth wireless (added $200)	Yes, with ZigBee wireless (added $200)
Additional software needed	None	Yes, Travel diary survey software is needed.	None
Advantages	Small, lowest cost, some have motion detection to trigger logging	Low cost, available now, and no manufacturing risk	Long run-time, secure data storage for long travel survey, Custom software menu which allows the survey respondent to fill out the survey questionnaire quickly and easily, Long-term availability, Future integration to OBD-II
Risk factors	User will still have to fill out travel survey information on paper	Long-term availability is in question. These products change every year. The travel survey software written for this unit may have to be rewritten for future similar devices (risk - medium).	Parts are generally available for 4 to 5 years. Software development risk (low) Finding contract manufacturers to make the device (medium) Making GPS-ATD in time for 2010 survey (high) Higher manufacturing cost than predicted (medium)

Table 2: Comparison of GPS-ATD and additional commercially-available GPS-enabled devices

	Passive GPS Logger	Passive GPS Logger	PDA with GPS	PDA with GPS	GPS-ATD
					
Description	Passive GPS logger: AGL3080, RBT-2300, RGM-3800, GiSTEQ	Genie GT-31 with SD storage	PDA with GPS: Airis T610 or T620, Pharos GPS 535, Asus MyPal A696	Rugged GPS/PDA	GPS-ATD (Automated Travel Diary)
Storage size	~ 400,000 to 1.3 million points 100 to 250 hrs @ 1Hz	Up to 2 GB with SD card	Up to 2 GB with SD card	Up to 4 GB with SD card	Built-in 256 MB
Run-Time	8 hrs to 22 hrs	30 hrs	4 to 6 hrs (1200 mAh battery)	~ 6 hrs (1200 mAh battery)	~ 11 hrs (1800mAh battery)
Data security	None	None	None Data encryption may be option	None	Yes (only authorized personnel can download data)
Data integrity	None (Anyone can modify the data easily)	None (Anyone can modify the data easily)	None (Anyone can modify the data easily) Data encryption may be an option	None (Anyone can modify the data easily) Data encryption may be an option	Yes (Nobody can modify the data)
Size	9.0 x 4.6 x 2.3 cm 7.0 x 3.7 x 2.4 cm	Not available	11.5 x 7.2 x 1.8 cm 11.7 x 7.1 x 1.6 cm	10.9 x 6.0 x 1.9 cm	11.7 x 6.6 x 2.1 cm
Weight	Smallest: ~50 g (2.0 oz)	Not available	Medium: 170 g (6 oz)	Medium 133 g (4.7 oz)	Medium: 142 g (5.0 oz)
User Interface for Data input	None	None	Yes	Yes	Yes
Strong sunlight readability	N/A	Good	Good	Good	Best
GPS chipset performance	Good to Best (SiRF III, MTK, or NEMERIX)	Best (SiRF III)	Best (SiRF III)	Good	Best (SiRF III)
Cost	Lowest ($55 to $120)	$160	$199 to $380	$650	~$500 @ QTY=1000 (estimate)
Future integration to OBD-II	None	None	Yes, with Bluetooth wireless (added $200)	Yes, with Bluetooth wireless (added $200)	Yes, with ZigBee wireless (added $200)
Additional software needed	None	None	Yes, Travel diary survey software is needed.	Yes, Travel diary survey software is needed	None
Advantages	Small, lowest cost, some have motion detection to trigger logging	Small, low cost, large storage	Low cost, available now, and no manufacturing risk	Rugged, available now, and no manufacturing risk	Long run-time, secure data storage for long travel survey, custom software menu which allows the survey respondent to fill out the survey questionnaire quickly and easily, Long-term availability, Future integration to OBD-II

Risk factors	User will still have to fill out travel survey information on paper	User will still have to fill out travel survey information on paper	Long-term availability is in question. These products change every year. The travel survey software written for this unit may have to be rewritten for future similar devices (risk - medium).	Long-term availability is better than GPS/PDA	Parts are generally available for 4 to 5 years. Software development risk (low) Finding contract manufacturers to make the device (medium) Making GPS-ATD in time for 2010 survey (high) Higher manufacturing cost than predicted (medium)

SECTION 3:
EVALUATE PROMISING EXISTING COMMERCIAL SYSTEMS

After the current reassessment of alternative systems was completed, a number of the most promising units were procured for a field test. The three main variants used for this phase of testing were the: 1) GPS-ATD, 2) GPS-Enabled PDA platform, and 3) Passive Data logger.

AHMCT-Caltrans GPS-ATD

As part of the January 2005-December 2006 GPS-ATD project, AHMCT investigated the use of commercial-off-the-shelf (COTS) PDA systems with built-in GPS receiver as the platform for ATD development and deployment. The conclusion reached at the time was that no commercial system could meet the ~$500 per unit cost constraint. Note that COTS PDA systems with built-in GPS receiver were available for which software could be developed to meet most functional specifications, but these had unit costs far exceeding Caltrans cost constraints (~$2000 - ~$3000 per unit). Accordingly, therefore, as there were no available systems to meet the needs of the 2010 Survey, AHMCT researched, designed, and developed its own PDA platform from the TSI specifications. The units met TSI's functional requirements; however, during testing one performance issue was identified: the GPS reception was less sensitive than desired. AHMCT and TSI have discussed enhancements of the units, including the needed scope of work (time and funding); these enhancements have been deferred for future work, as no funding or contracting mechanism has been identified. It should be stressed that ***the prototype GPS-ATD meets all requirements and specifications, and is a viable platform for travel behavior surveys.***

With the needed GPS reception enhancements, contract manufacturing uncertainties and lags, and the proximity of the 2010 Travel Behavior Survey, at the time of this report (June 2008), it may still be feasible to use the AHMCT Caltrans GPS-ATD system; however, quick decision and action must be made by all parties. However, the risks of this approach must be carefully considered given the time constraints. It is estimated that, *assuming no contracting or external delays*, to reach availability from a manufacturer from start (prototype enhancements) to finish (delivery) two years would be required. The main risk factor would be identifying manufacturers and completing the necessary bidding and procurement processes. Due to vagaries in governmental laws and processes, this risk is difficult to mitigate and may be beyond control of AHMCT and Caltrans.

GPS-enabled PDA Platform

By removing the variability of the contract, bidding, and manufacturing processes, using a commercial-off-the-shelf (COTS) Personal Digital Assistant (PDA)-type system with built-in GPS receiver mitigates the risk of having to deploy a custom hardware solution. Costs savings from "economy of scale" manufacturing accrue automatically. By choosing an appropriate open software architecture platform, the platform firmware and the software developed in the GPS-ATD prototype research will be directly applicable and transferrable (with some modifications) onto a COTS-based PDA platform with

built-in GPS receiver. The user interface (UI) software developed under the prototype research can be ported to a Windows CE or Linux-base PDA with built-in GPS receiver.

The newly-available COTS GPS-enabled PDA platforms AHMCT has evaluated meet the needs for the integration of the AHMCT software and firmware for the survey. The units provide nearly the same functionality as the GPS-ATD as a platform to host the software. As a general purpose computing device, the units are programmable and additional functionality can be supported by adapting the UI. The units we have evaluated are now approximately 40% - 80% the estimated cost of the GPS-ATD hardware platform at effectively the equivalent functionality; this is to be expected based on the low volume and custom nature of the GPS-ATD vs. mass-market devices. Since these are general purpose computing devices, access to stored log data by the general public could be a concern; encryption of the data files will effectively address this issue. Another issue identified during testing is lower run times. Many of the COTS units have 4-6 hours of continuous run time (versus ~11 hours for the GPS-ATD platform). Aggressive power management, in-vehicle charging, and survey participant training to monitor and charge the units appropriately will mitigate the lower run times.

Passive Data Logger

Finally, the lowest-risk equipment item was evaluated – the passive GPS data logger. Additionally, these units are also the lowest-cost item, within the range of $60-$120 per unit. These units can augment the traditional paper travel diary forms with exact route and location data and require no user interaction other than turn them on and off and charging them appropriately. The units AHMCT has evaluated store between 400,000 and 1.3 million locations at a rate of 1 point per second, which translates into 100-250 hours of travel. Since these devices are not readily user-accessible, log data security should not be a problem. Survey participant training would need to be augmented to include these devices; however, training is minimal and includes how to turn them on and off and charge the batteries regularly.

SECTION 4:
INVESTIGATION OF SYNERGISTIC CONCEPTS

Whether based on the GPS-ATD hardware or on a COTS GPS-enabled PDA, either platform can support the diverse applications envisioned within Caltrans. Other state agencies may benefit from the leverage of the knowledge, firmware, software, and other technologies that were developed under the prototype GPS-ATD research. Location-based data, in conjunction with logging of the associated activities, is especially useful in gaining insight into the movement of people, goods, and services.

Current envisioned applications include monitoring the use of alternative fuels (e.g. E85), replacing paper vehicular usage logs with electronic logs, and fleet and asset management applications. For example, the California Air Resources Board (CARB) may use the alternative fuels data for fuel use and emissions studies that may result in the optimal placement of E85 refueling stations that would provide for the most cost-effective benefit for the public. Traffic data may provide support for congestion management techniques by various regional and county entities. Data obtained by Caltrans TSI or others can also be leveraged to support land-use planning and modeling.

For many applications, combining the ATD with additional sensors and data loggers will be an optimal approach. For example, for CARB studies, the ATD would provide the full range of data obtained in travel surveys. Instrumenting vehicles with an additional data logger connected to the On-Board Diagnostics (OBD-II) port would allow collection of engine data and parameters of interest to CARB. Such data may include fuel use and economy data, when such data is available in a standardized format for that vehicle and engine type. As the ATD and typical data loggers maintain an internal clock setting, and the systems can be sufficiently synchronized, it will be feasible to correlate the ATD and OBD-II vehicle data during post-processing, supporting a wide range of analysis and reporting.

In a similar manner, the ATD can be combined with additional sensors and data loggers to monitor the use of alternative fuels. For example, it is feasible to monitor the percentage use of E85 in the recently purchased Caltrans fleet of flex-fuel vehicles. Such a system would include a modified (reprogrammed) ATD as the UI and vehicle-to-office communications, and would combine with a back-office server system for a user-friendly web-based interface for supervisors and managers to visualize data and statistics. This capability would allow data-driven and objective decisions regarding fleet and fuel usage, and the deployment of additional flex-fuel filling stations.

The ATD, with software modifications, would also provide an excellent in-vehicle usage log. The system could replace current paper logs for vehicle use. The addition of location tracking along with potential interfaces to other vehicle sensing systems would make the vehicle log easier to use, while simultaneously providing a greatly enhanced tool for Caltrans (or other agency) fleet management.

SECTION 5:
SUPPORT FSR DEVELOPMENT

Introduction to FSR Development

In order to support Caltrans' development of the business case for the introduction of an ATD device into the 2010 Travelers' Survey, a more through understanding by AHMCT of the California State governmental business and legislative processes was needed. Through numerous conversations with representatives from the State Chief Information Office (CIO), the Feasibility Study Report (FSR) generation process was deemed the best starting point. Towards that end, two AHMCT researchers (Kin Yen and Phillip Wong) attended the in-house FSR orientation sessions at Caltrans headquarters. Kin Yen attended the May 14, 2008 session, and Phillip Wong attended the May 16, 2008 session. These sessions were comprehensive all-day sessions that reviewed the rationale and purpose of the FSR, as well the procedures for properly compiling the report for eventual inclusion with and support of the Budget Change Proposal (BCP). Heavy emphasis was placed on discussing within the FSR the impact of the proposed new project development on the existing capacity and security of Information Technology (IT) infrastructure. Concise project goal setting and project milestones were also emphasized as a means of project cost-containment. A quick summary of the rationale and process for the FSR follows.

Table 3: FSR Development Summary Table[2]

What is an FSR?	Feasibility Study Report is required for IT projects; This document explains the project need and explains the rationale for selecting the preferred alternative above other alternatives.
What is an IT project?	• Any project, or project component, that creates computerized and automated information used to make decisions, or delivers infrastructure upon with information travels. • Rule of thumb – if the project involves analysis or storage of data, it is most likely an IT project.
Why does the FSR matter?	• Documents the business need for the project • Shows due diligence • Documents the rationale • Provides decision making information
Developing a Project Concept	• Documents business case for approving funds to conduct a Feasibility study • Explains **what** the problem is and **why** it needs to be fixed – ***not how***.

[2] Office of Project Implementation (OPI), http://it.dot.ca.gov/projmgmt, 916.651.8474

Why is a feasibility study important?	• Business problem is well understood and quantified. • Defines nature and scope of the project • Defines project objectives and performance measures • Expected benefits are analyzed and quantified • Best solution is identified • Improves likelihood of achieving business objectives
10 Steps to A Feasibility Study	1. Assemble team 2. Define business problem or opportunity 3. Analyze existing processes or environment 4. Determine business objectives 5. Determine business functional requirements 6. Identify or evaluate alternatives 7. Select best alternative 8. Develop project plan 9. Evaluate study results 10. Document study results
Success Factors	• Involve IT early and often • Identify all stakeholders • Set project business objectives • Identify and evaluate all reasonable alternatives • Select the alternatives that will achieve the objectives
Key Messages	• FSR is required by law • FSR due to IT by December • FSR due to Finance by July • BCP due to Finance by September • FSR must be approved **before** IT project starts

ATD FSR Information Development

In support for the generation of the FSR, AHMCT researched and summarized various IT scenarios for the implementation of the ATD into the travelers' survey. The scenarios considered generally involved the partitioning of responsibility between the contractor and Caltrans. The table below summarizes the various scenarios discussed between AHMCT and Caltrans. Graphics depicting the various scenarios follow the summary table.

Table 4: Scenario Summary

Scenario	1. CaltransAll	2. ContractorAll	3. ContractorGIS	4. ContractorAnalysisGIS	5. ContractorAnalysis
Data download	Caltrans	Contractor	Caltrans	Contractor	Contractor
Data analysis	Caltrans	Contractor	Caltrans	Contractor	Contractor
Query	Caltrans	Contractor	Caltrans	Caltrans	Caltrans
GIS	Caltrans	Contractor	Contractor	Contractor	Caltrans
FSR needed	Yes	No	Yes	Yes	
S/W paid by	Caltrans	Contractor	Caltrans	Contractor	Contractor
Security issues	USB download	None	USB download, Feed from contractor GIS	None	Feed from Caltrans GIS
Who maintains s/w	Caltrans	Contractor	Caltrans	Contractor / Caltrans	Contractor / Caltrans
Training needed?	Yes	No	Yes	No	No
Benefit to Caltrans	Full capability internal to Caltrans, may facilitate sharing with other agencies	No burden on Caltrans for implementation, training, analysis	TBD	Ability to perform advanced queries, possible sharing with other agencies	Ability to perform advanced queries, possible sharing with other agencies
Drawback to Caltrans	Burden of implementation, training, analysis	No enhanced capability internal to Caltrans, difficulty sharing with other agencies	TBD	Mixed model, so some drawbacks incurred. Uncertain benefit of GIS at contractor.	Cannot perform detailed analysis, which will increase cost for supplemental surveys

Scenario	**1. CaltransAll**	**2. ContractorAll**	**3. ContractorGIS**	**4. ContractorAnalysisGIS**	**5. ContractorAnalysis**
Notes	This is the high-goal view. It requires development of the analysis and visualization tools. It will definitely require an FSR. This is the approach that AHMCT envisioned in our discussions, and provides the greatest capability to Caltrans TSI. However, there is the associated "cost" of FSR, and the associated implementation, training, and maintenance to be considered.	This is the low-goal view. The analysis tools will still be needed, but could be developed by the contractor. It will not need an FSR, as Caltrans will simply receive flat files. Caltrans TSI will gain no capabilities, except having the data collected by the ATD, and the ability to perform simple visualizations. No increased burden to Caltrans for training and maintenance, but issues with sharing info to agencies.	Not certain whether this is a scenario of any interest	Need to discuss whether any benefit in having GIS at contractor (except for scenario 2). Caltrans will be able to perform advanced queries. This will require some development for Caltrans, as well as issues with maintenance. There may be a need for training. Often, mixed approaches provide most of the drawbacks, and little benefit.	Caltrans will be able to perform advanced queries. This will require some development for Caltrans, as well as issues with maintenance. There may be a need for training. Often, mixed approaches provide most of the drawbacks, and little benefit.

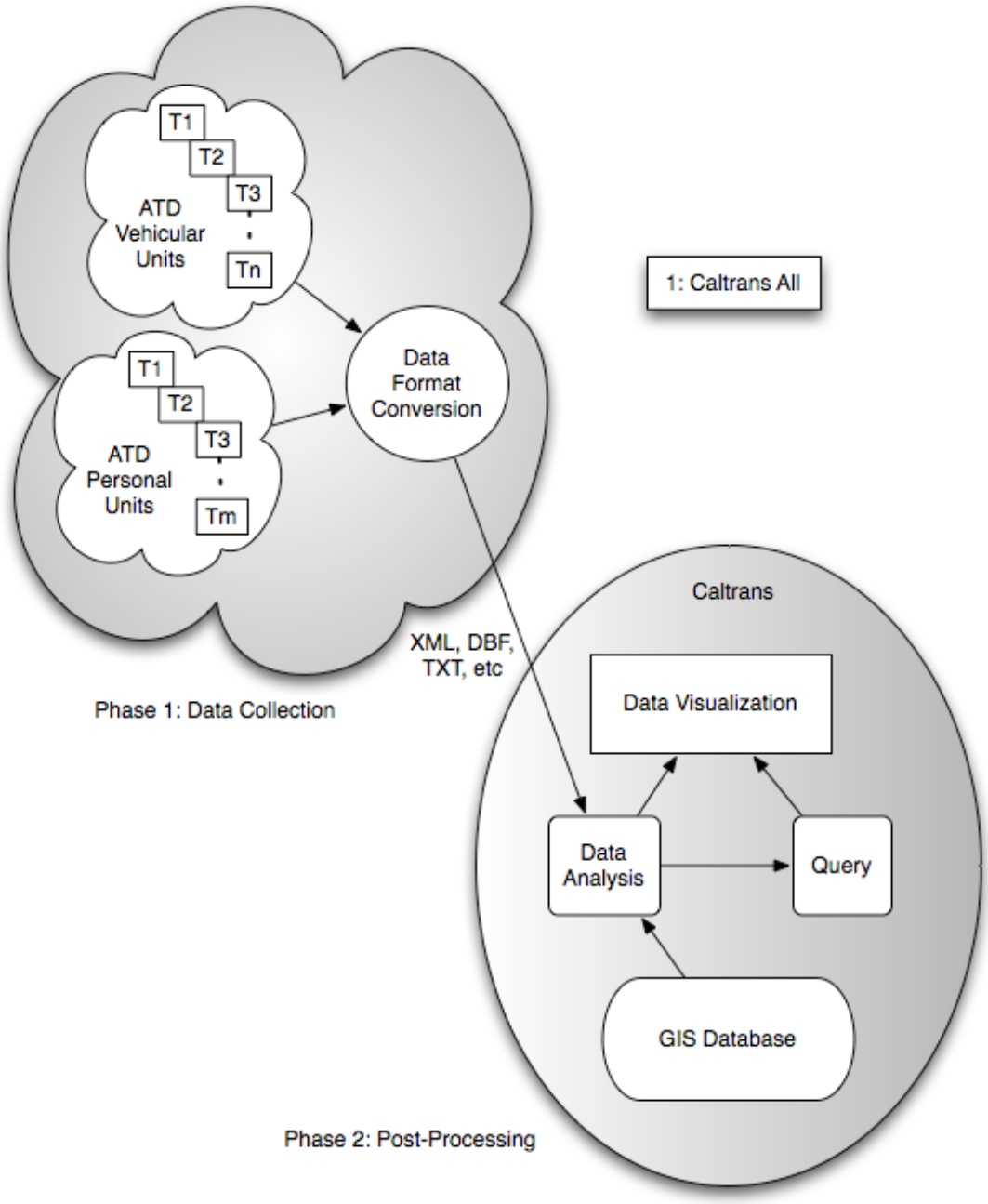

Figure 2: Caltrans All / No Contractor Involvement

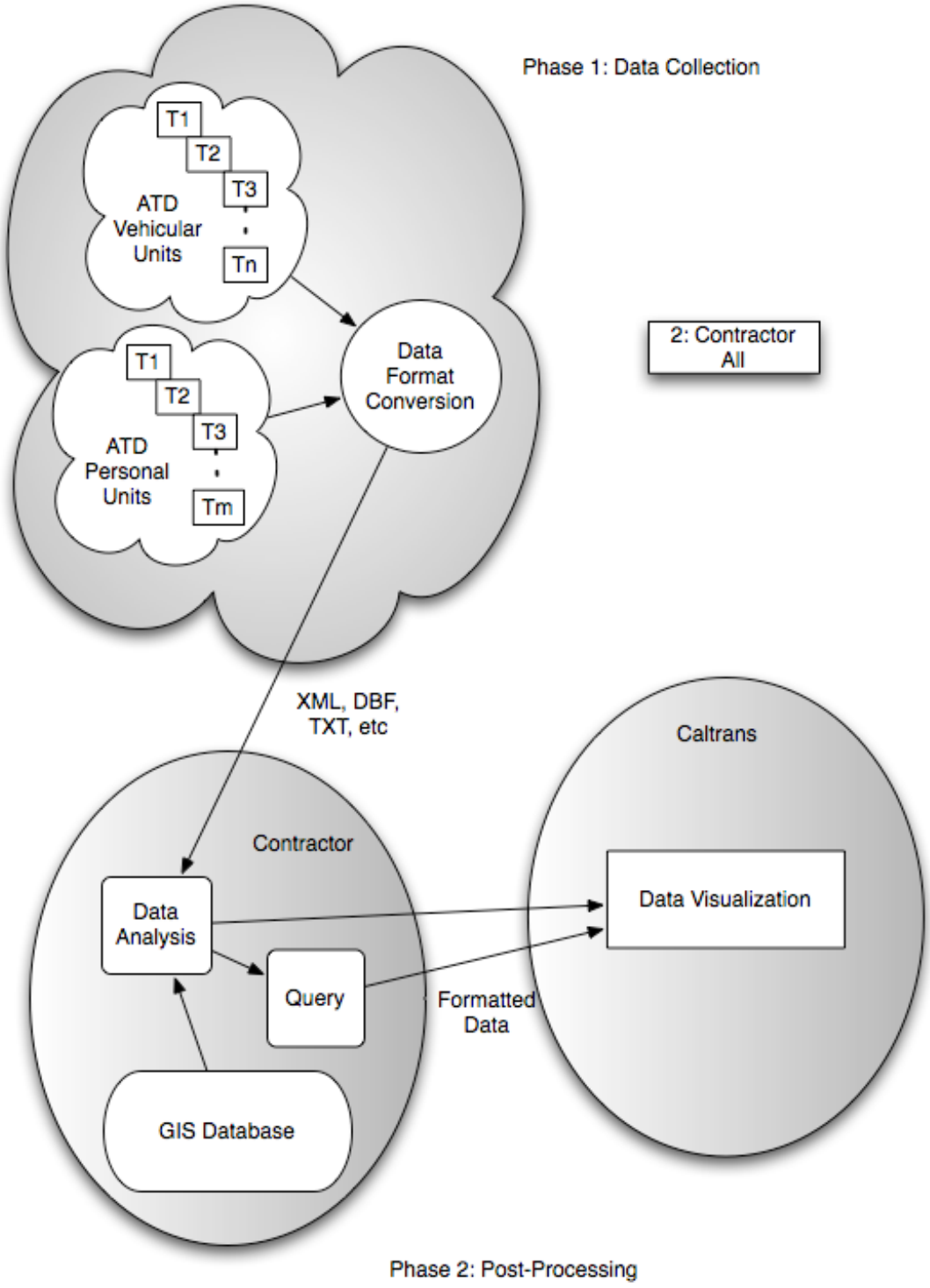

Figure 3: Caltrans Visualization / Contractor Full Responsibility

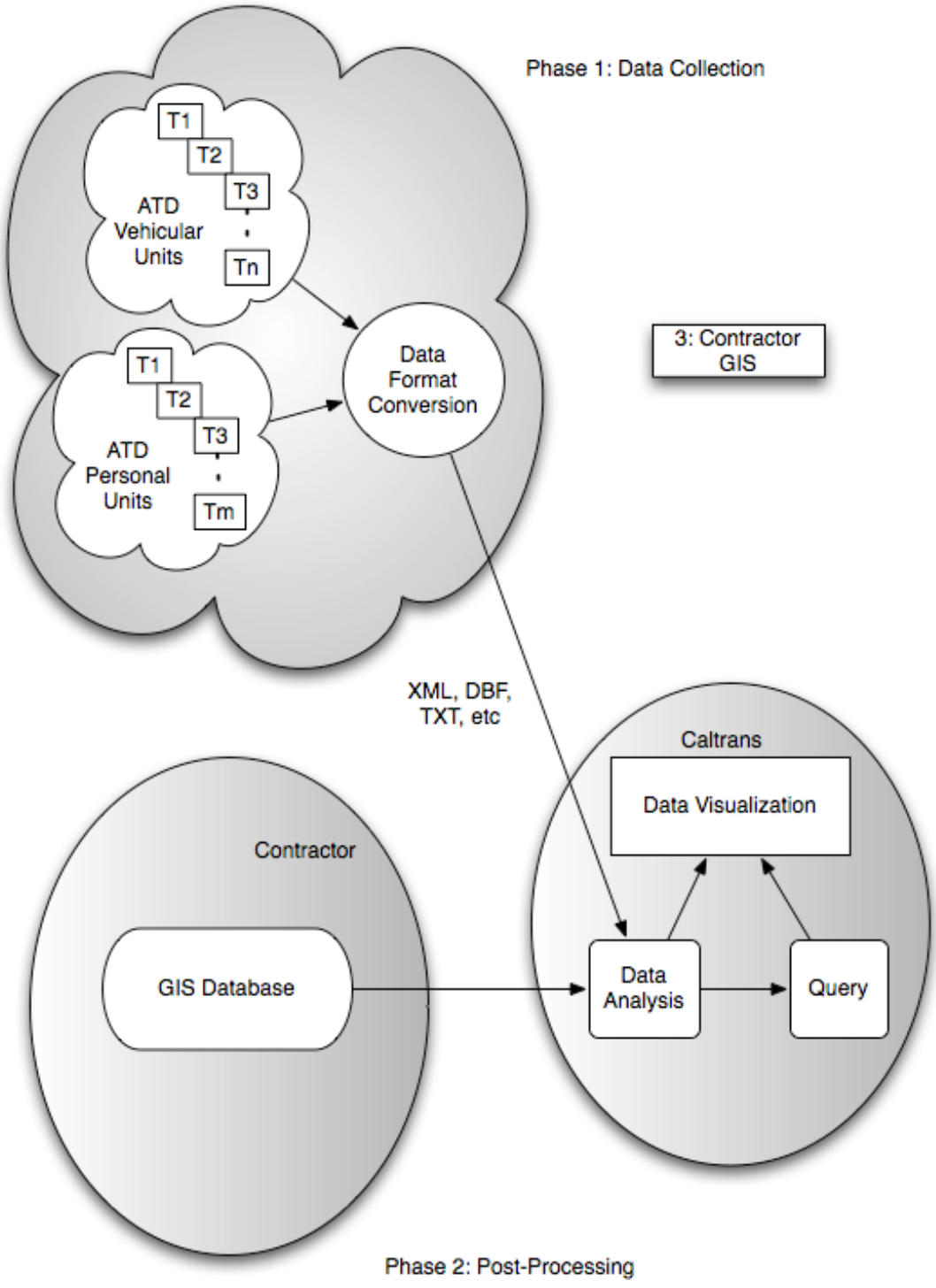

Figure 4: Caltrans Visualization / Contractor Geo-location Processing

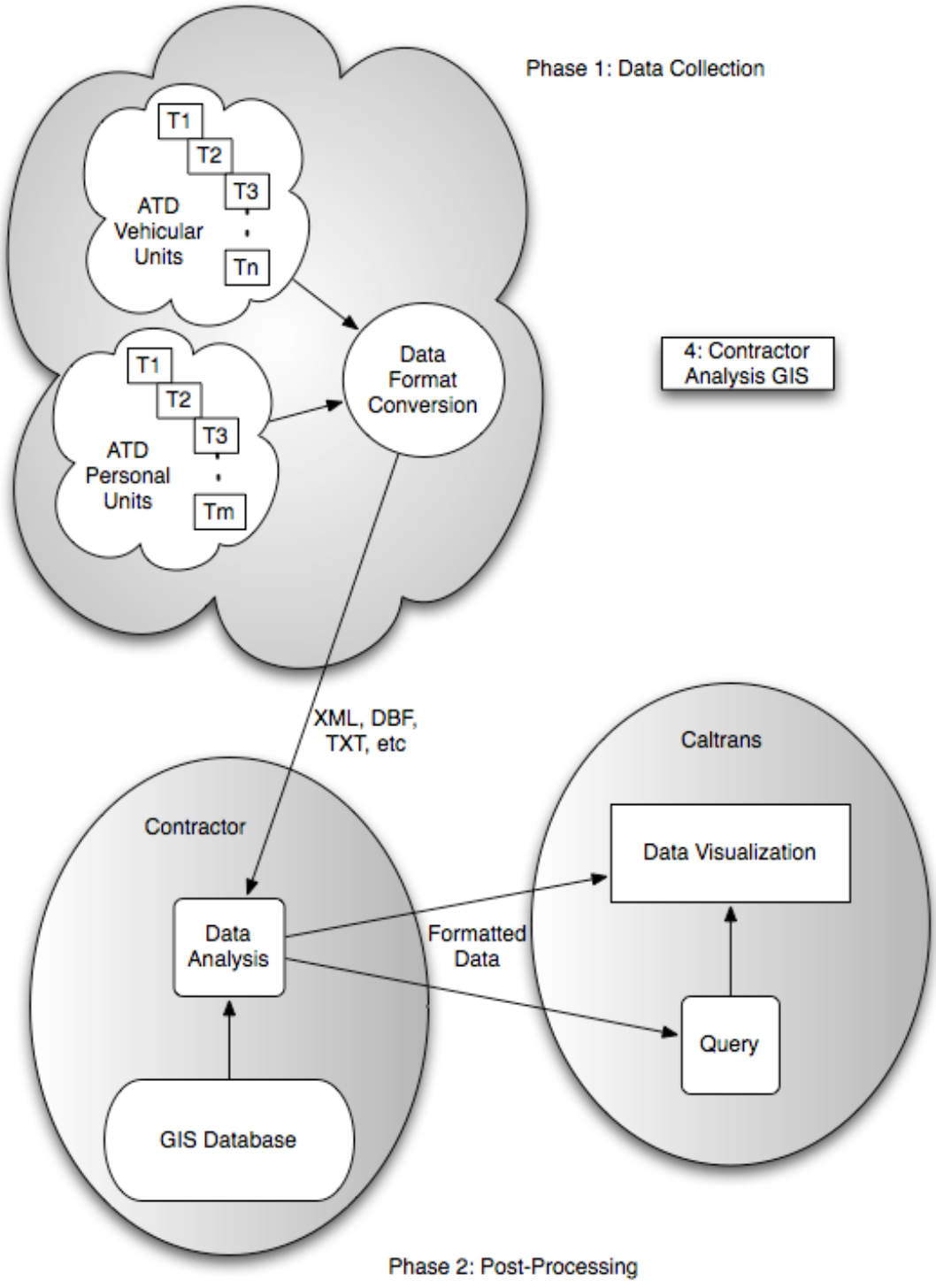

Figure 5: Caltrans Visualization / Contractor Data Analysis & Geo-location

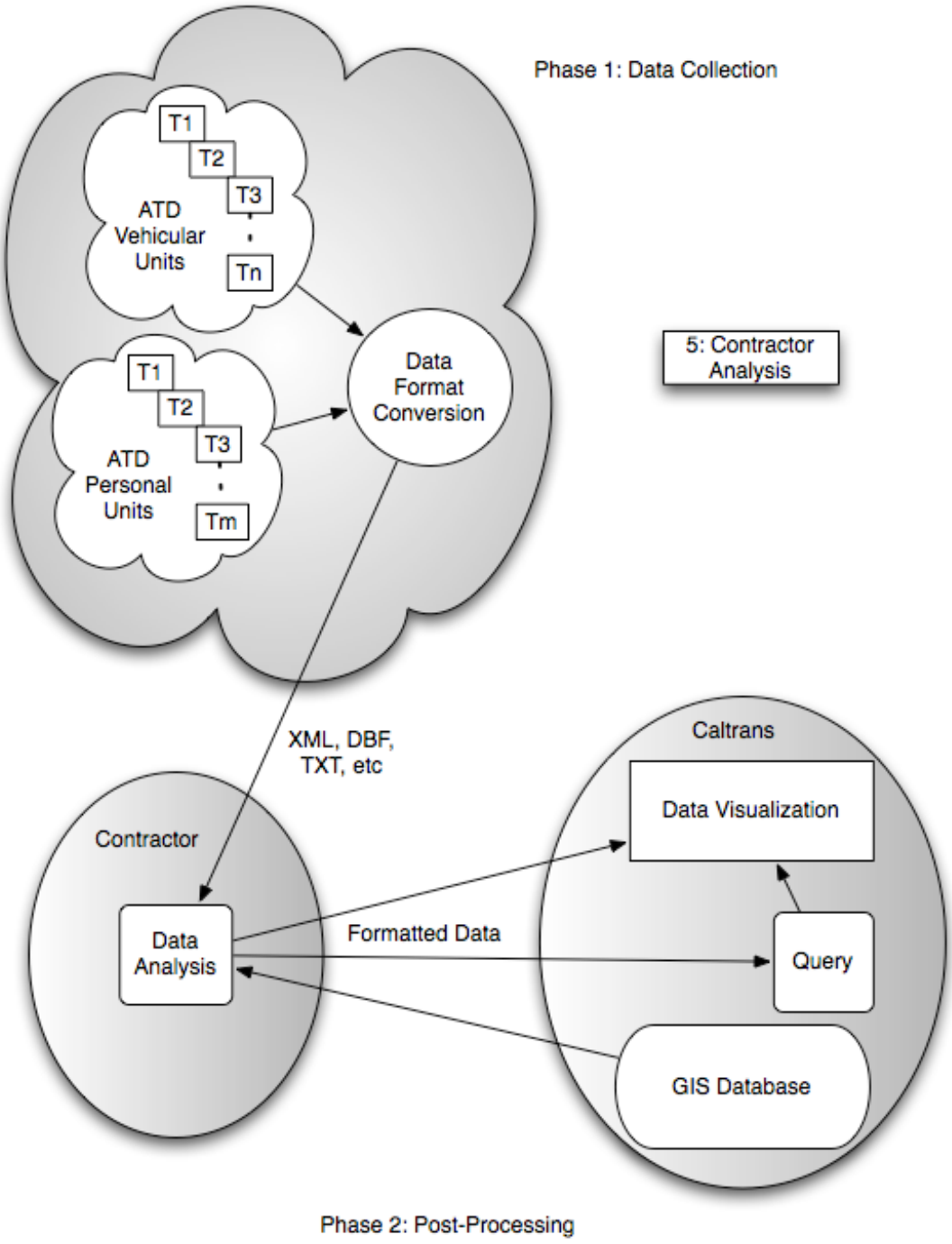

Figure 6: Caltrans Visualization / Contractor Data Analysis

SECTION 6:
SUPPORT DEVELOPMENT OF THE BCP

In support of the generation of the Budget Change Proposal (BCP), AHMCT met approximately once a month with TSI and DRI to provide supporting information for inclusion into the BCP. The supporting information has been summarized in Sections 2 through 5 in this report.