

Southern California Priority Corridor
Showcase Program Evaluation

San Diego Regional Interconnect Project (InterCAD) Evaluation Report

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Disclaimer

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

Abbreviations & Acronyms

ARJIS	Automated Regional Justice Information System
ATIS	Advanced Traveler Information System
ATMS	Advanced Transportation Management System
AVL	Automatic Vehicle Location
CAD	Computer Aided Dispatch
Caltrans	California Department of Transportation
CCTV	Closed-circuit Television surveillance camera
CDF	California Department of Forestry
CHP	California Highway Patrol
CM	Configuration Management
CMP	Configuration Management Plan
CMS	Changeable Message Sign
CNF	Cleveland National Forest
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off-the-Shelf
CTC	California Transportation Commission
CVO	Commercial Vehicle Operations
CW	Corridor-wide
CWATIS	Corridor-wide Advanced Traveler Information System Project
CWATMS	Corridor-wide Advanced Transportation Management System Project
CWCVO	Corridor-wide Commercial Vehicle Operations Project
CWSIP	Corridor-wide Systems Integration Project
CWSPP	Corridor-wide Strategic Planning Project
DOIT	Department of Information Technology
DRI	Caltrans Division of Research & Innovation (formerly NTR)
EAP	Evaluation Activity Plan
EP	Evaluation Plan
Federal Fire	Commander Naval Region Southwest, Public Safety Office, Force Protection
FHWA	Federal Highway Administration
FSR	Feasibility Study Report
FTA	Federal Transit Administration
FTE	Full-Time Equivalent (one full-time employee)
GPRA	Government Performance Reporting Act
GUI	Graphical User Interface
HP	Hewlett-Packard
HQIT	Headquarters – Information Technology (division of Caltrans)
IDL	Interface Definition Language
InterCAD	San Diego Regional Computer Aided Dispatch Interconnect Project
IMX	InterCAD Message Exchange
IPR	Intellectual Property Rights
ITS	Intelligent Transportation Systems
ISSC	Information Systems Service Center (division of Caltrans)
ISTEA	Intermodal Surface Transportation Efficiency Act (of 1991)

LACDPW	Los Angeles County Department of Public Works
LADOT	City of Los Angeles Department of Transportation
LAN	Local Area Network
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
MQ	IBM Message Queue Manager Product Series
MQM	Message Queue Manager
MTA	Los Angeles County Metropolitan Transportation Authority
MTBF	Mean Time Between Failure
NDA	Non-Disclosure Agreement
NTCIP	National Transportation Communications for ITS Protocol
NTR	Caltrans Division of New Technology & Research (now DRI)
O&M	Operations and Maintenance
ORB	Object Request Broker
OS	Operating system (such as Windows™, Unix, Linux, et. Al.)
PC	Personal Computer (Windows™-based)
RCTC	Riverside County Transportation Commission
RFP	Request for Proposals
RTP	Regional Transportation Plan
RTPA	Regional Transportation Planning Agency
RWS	Remote Workstation
SAFE	Service Authority for Freeway Emergencies
SANBAG	San Bernardino Association of Governments
SANDAG	San Diego Association of Governments
SANNET	San Diego Network
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCPCSC	Southern California Priority Corridor Steering Committee
SDPD	San Diego Police Department
SDSO	San Diego Sheriffs Office
SIP	Systems Integration Plan
SMDS	Switched Multi-megabit Data System
T-Cubed	TeleTran Tek Service (see also T3)
T3	TeleTran Tek Service (see also T-Cubed)
TAG	Technical Advisory Group
TAS	Technical Advisory Subcommittee
TEA-21	Transportation Equity Act for the 21st Century
TMC	Transportation Management Center
TMS	Technical Management Subcommittee
USDOJ	United States Department of Justice
USDOT	United States Department of Transportation
VDS	Vehicle Detector Station
VOS	Volume/Occupancy/Speed
WAN	Wide Area Network

Executive Summary

Background

As required by federal law, all Intelligent Transportation System (ITS) projects that receive federal funding must undergo an evaluation to help assess the costs and benefits of ITS. This document is one of 23 reports produced as part of the Southern California ITS Priority Corridor (SCPC) Showcase Program Evaluation to help planners and decision-makers at the federal, state and local levels make better-informed decisions regarding future ITS deployments. This report presents the experiences, costs, and lessons learned from the San Diego Regional Computer Aided Dispatch (CAD) Interconnect (InterCAD) project.

In 1993, the U.S. Department of Transportation designated Southern California as one of four Priority Corridors in which ITS could have particular benefit. Southern California suffers from extreme traffic congestion, limited room for expanding transportation facilities, and above-average air pollution levels. The Southern California Priority Corridor is one of the most populated, traveled, and visited areas in the country, and consists of four adjoining regions:

- ▶ Los Angeles/Ventura
- ▶ Orange County
- ▶ San Diego County
- ▶ Inland Empire (San Bernardino and Riverside Counties).

The ITS Showcase Program is one of several programs that have been implemented in Southern California's Priority Corridor to help aid mobility and mitigate traffic congestion and its associated environmental impacts. The Showcase Program consists of 17 ITS projects that collectively form a corridor-wide intermodal transportation management and information network between Los Angeles, Orange County, San Diego, and the Inland Empire. Each Showcase project deploys a piece of this corridor-wide ITS network, including regional Advanced Traveler Information Systems (ATIS), regional Advanced Transportation Management Systems (ATMS), and regional and interregional communications infrastructure. Eleven of the projects are regional in nature, while the remaining six are corridor-wide. The InterCAD project is one of five San Diego regional projects within the Southern California Priority Corridor ITS Showcase Program.

San Diego InterCAD – the San Diego Regional Computer Aided Dispatch (CAD) Interconnect project – is a Showcase Early Start Project originally developed to facilitate improved highway incident management in San Diego County. The system would enable rapid coordination of interagency response to multi-jurisdictional incidents. More specifically, InterCAD would improve the transfer of time-critical and incident-related information between selected operator positions within the participating agencies' communication centers. InterCAD would provide a fast, secure data messaging and electronic mail system between Computer Aided Dispatch (CAD) supervisors at emergency service, first response, law enforcement, and transportation agencies. The design involves a defined set of messages that all CAD systems can be

programmed to read and send. InterCAD did not seek to integrate agency systems, but only to facilitate their interconnection through system-independent messaging.

The project consisted of two phases. Phase I included a concept demonstration and feasibility analysis in cooperation with three law enforcement agencies: San Diego Police Department (SDPD), the San Diego Sheriff's Office (SDSO), and the California Highway Patrol (CHP) Border Division. Phase I was funded by local funds and the Service Authority for Freeway Emergencies (SAFE). SAFE contributed funding from its operating reserves to complete Phase I of the InterCAD San Diego project in 1996. Phase II of the InterCAD project commenced shortly after the completion of Phase I, and entailed an expansion and demonstration of the Phase I capabilities. Phase II of the project was funded by the Showcase Program and expanded the Phase I participation to include eight more emergency response, fire, and law enforcement agencies. However, only the following five agencies ultimately participated in the Phase II operational test:

- ▶ Caltrans District 11 Transportation Management Center (TMC)
- ▶ Federal Fire Department
- ▶ Heartland Communications
- ▶ California Department of Forestry/Cleveland National Forest.

Phase II also intended to integrate InterCAD to the Showcase Network via the San Diego Kernel when this capability was made available. The Kernels and Showcase Network were being developed concurrently as part of Showcase's Scoping & Design project.

Evaluation Findings, Conclusions, and Recommendations

Incidents that cross jurisdictional boundaries can result in coordination problems. Although most response agencies use computer systems and wireless communications systems to manage their resources and to direct field response, these various systems often do not inter-operate and the agencies do not have a wide area data communications capability. InterCAD's vision was to streamline and expedite this interagency communication in mutual aid emergency response situations, and dramatically improve regional coordination of multi-jurisdictional incident response through data communications. However, institutional challenges limited the project's success.

Concerns over data security limited the participation of law enforcement agencies in the InterCAD Phase II project. Several reasons contributed to the law enforcement agencies' data security concerns:

- ▶ Uncertainty regarding the security of the InterCAD system and network
- ▶ Department of Justice requirements and recent audits/inquiries
- ▶ Departure of agency management and staff involved in InterCAD Phase I

The evaluator proposes the following recommendations to assist multi-jurisdictional projects, such as InterCAD, to achieve their vision, be successfully deployed, and to be fully integrated into the processes and procedures of the participating agencies:

1. *Be aware of the institutional barriers to participation by law enforcement agencies, and develop a task force or conduct a workshop to address these barriers in future expansions of the InterCAD system or other similar projects.*

The objective of this task force or workshop is:

- ▶ To understand what limitations/barriers exist to keep law enforcement from further participating in Phase II (it is noted that CHP has made available the MediaCAD incident data via the Internet),
- ▶ To determine if there is a method to overcome those limitations/barriers,
- ▶ To decide what needs to be accomplished/changed to overcome identified limitations/barriers and secure further participation,
- ▶ If limitations/barriers are overcome, to determine what then will be the role of law enforcement agencies in this or other Showcase projects,
- ▶ To agree to future actions and a schedule to move forward.

As the organization responsible for transportation planning in the region, SANDAG is the most likely candidate to coordinate and facilitate such a task force or workshop. Participants should include, but not necessarily be limited to, the following agencies:

- ▶ Caltrans
- ▶ California Highway Patrol (local and headquarters staff)
- ▶ San Diego Police Department
- ▶ San Diego Sheriffs Department
- ▶ U.S. Department of Justice

Specific suggestions provided by CHP for participation in such a workshop include members of the Information Management Division (IMD) such as the Information Security Administrator, Network Management Section, CAD/MDC Unit, technical support officer, or others deemed appropriate by the Division Chief. While this law enforcement issue is specific to InterCAD, the lessons learned may be carried forward to other projects with multiple agency involvement.

Furthermore, since ITS projects often require a change in agency operations policies and procedures, it is imperative to have the involvement of upper management, executive boards, or even legislative bodies.

2. *Develop a mechanism for continued involvement in corridor-wide Showcase activities.*

Standard system interfaces defined by the Showcase Program enable the dissimilar systems throughout the Southern California Priority Corridor to interoperate and exchange information. As technology evolves and systems change, each region must remain in sync with the rest of the Priority Corridor by participating in the standards review process.

3. *InterCAD Phase II participating agencies should develop a task to produce a detailed procedural Concept of Operations.*

Operations and maintenance procedures and policies were not established by participating agencies during the InterCAD project, but the project team identified that future projects will benefit from developing such policies early as part of a Concept of Operations. In order to be meaningful, the operations concept must be developed at a level of detail such that all agency partners fully understand their roles when system operations commence, and the operations concept has full support from the agencies' upper management. Such detailed agency-specific Concepts of Operations will aid the integration and mainstreaming of InterCAD into the processes and procedures of each participating agency.

This Executive Summary has highlighted some of the issues encountered to date with the InterCAD project. The Evaluator believes that corresponding lessons learned will be beneficial to the ongoing development of the InterCAD project, other Showcase projects, and the Showcase Program as a whole.

1 Introduction

1.1 Purpose and Scope of this Report

As required by federal law¹, all Intelligent Transportation System (ITS) projects that receive federal funding must undergo an evaluation to help assess the costs and benefits of ITS. The information provided in this report is intended to help planners and decision-makers at the federal, state and local levels make better-informed decisions regarding future ITS deployments based on the experiences of Southern California's San Diego Regional Computer Aided Dispatch Interconnect (InterCAD) Project.

This document is one of 23 reports produced as part of the Southern California ITS Priority Corridor Showcase Program Evaluation, and covers only the events and findings resulting from the InterCAD evaluation. The complete set of findings from the Showcase Program Evaluation are found in the following collection of documents:

Document Type/Title	Date	Document Number
17 Individual Project Evaluation Reports		
Corridor-wide ATIS Project Report	TBD	
Corridor-wide ATMS Project Report	TBD	
Corridor-wide CVO Project Report	TBD	
Corridor-wide Rideshare Project Report	TBD	
Corridor-wide Strategic Planning Project Report	10/29/2002	65A0030/0028
Fontana-Ontario ATMIS Project Report	TBD	
IMAJINE Project Report	3/17/2003	65A0030/0029
IMTMC Project Report	TBD	
InterCAD Project Report	4/2/2003	65A0030/0030
Kernel Project Report (Draft)	4/1/2003	65A0030/0031
LA ATIS Project Report	TBD	
Mission Valley ATMIS Project Report	TBD	
Mode Shift Project Report	TBD	
OCMDI Project Report	TBD	
Traffic Signal Integration Project Report	TBD	
Transit Mgt System Project Report	TBD	
TravelTIP Project Report	TBD	
5 Cross-Cutting Evaluation Reports		
System Performance Cross-Cutting Report	TBD	
Costs Cross-Cutting Report	TBD	
Institutional Issues Cross-Cutting Report	TBD	
Information Management Cross-Cutting Report	TBD	
Transportation System Impacts Cross-Cutting Report	TBD	
Final Summary Evaluation Report		
Showcase Program Evaluation Summary Report	TBD	

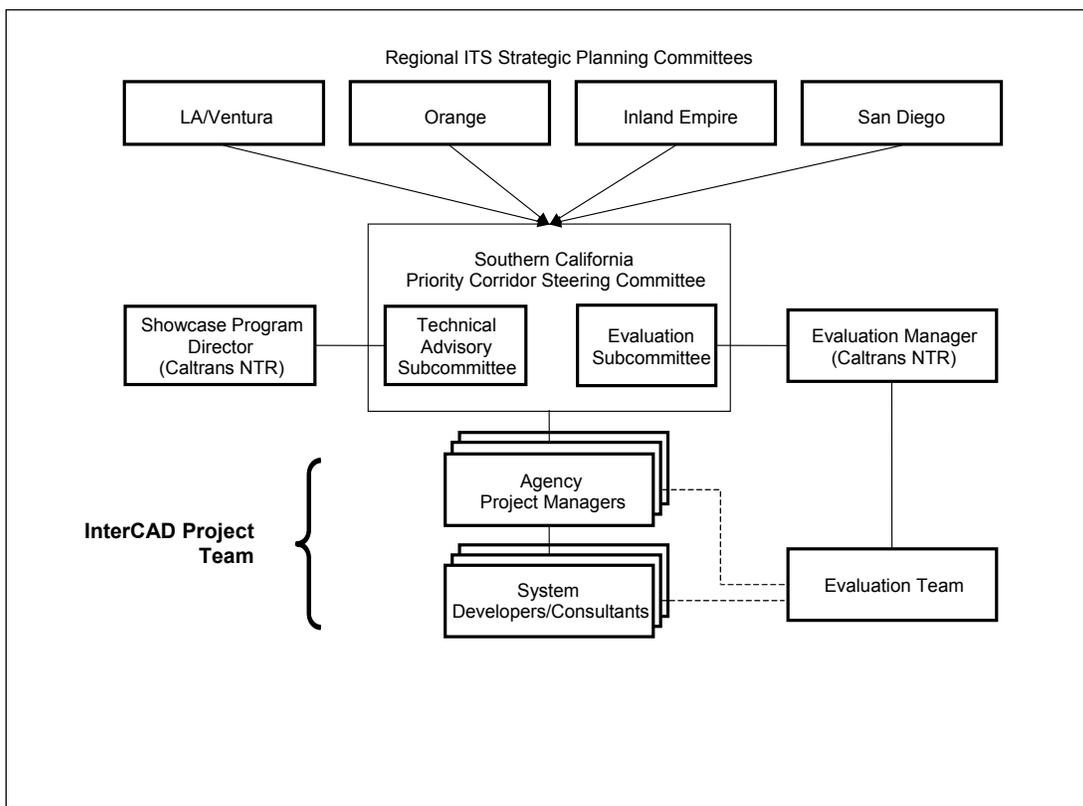
"TBD" indicates a future deliverable that is not yet available.

1.2 Evaluation Design and Approach

The findings outlined in this report are based on over six years of evaluator observations at project meetings, reviews of released project documents and agency memos, along with formal and informal interviews and discussions with project partners.

The evaluation is responsive to the needs and suggestions of the Priority Corridor’s Evaluation Subcommittee, which reports to the Priority Corridor’s Steering Committee and is comprised of stakeholders from the federal, state, and local levels as shown in Exhibit 1. The InterCAD project team was composed of various agency personnel, consultants, and system developers.

Exhibit 1 – Management Structure and Organization of the Showcase Program



The Steering Committee’s member agencies reflect wide representation from the region in terms of federal and state highway agencies, public safety, cities and counties, transit, air quality and regional planning entities, including:

- ▶ California Highway Patrol (CHP)
- ▶ Caltrans, Division of Research & Innovation (DRI) (formerly the Division of New Technology & Research (NTR))*
- ▶ Caltrans, District 7*
- ▶ Caltrans, District 8*
- ▶ Caltrans, District 11*

- ▶ Caltrans, District 12
- ▶ City of Irvine*
- ▶ City of Los Angeles Department of Transportation (LADOT)
- ▶ City of San Diego
- ▶ Federal Highway Administration (FHWA)*
- ▶ Federal Transit Administration (FTA)
- ▶ Los Angeles County Metropolitan Transportation Authority (MTA)
- ▶ Orange County Transportation Authority (OCTA)
- ▶ Riverside County Transportation Commission (RCTC)
- ▶ San Bernardino Association of Governments (SANBAG)
- ▶ San Diego Association of Governments (SANDAG)
- ▶ South Coast Air Quality Management District (SCAQMD)
- ▶ Southern California Association of Governments (SCAG).

* Indicates an Evaluation Subcommittee member

The Showcase Program’s Evaluation Design is based on a set of evaluation Goals and supporting Objectives and Measures that were developed by the Evaluation Team in partnership with federal, state and local stakeholders, and documented in the “Showcase Program Evaluation Approach” in 1998. Each individual Showcase project is evaluated based on an applicable subset of these Goals, Objectives, and Measures in order to help ensure that summary evaluation results can be aggregated from across the multiple Showcase project evaluations. The Showcase Program’s five evaluation Goals include:

- ▶ Evaluate System Performance
- ▶ Evaluate Costs
- ▶ Evaluate Institutional Issues and Impacts
- ▶ Evaluate the Use and Management of Transportation/Traveler Information
- ▶ Evaluate Transportation System Impacts.

During the InterCAD evaluation period, project-specific refinements to the evaluation design were documented in a high-level Evaluation Plan (EP) and a detailed Evaluation Activity Plan (EAP). In general, the EP describes the project and/or system under evaluation, and lays the foundation for further evaluation activities by developing consensus among the Evaluation Subcommittee and project partners as to which of Showcase’s evaluation Goals, Objectives, and Measures best apply to the project.

As the project matured, and after the EP had been approved, an EAP was developed to plan, schedule, and describe specific activities (e.g., interviews, surveys) and step-by-step procedures for conducting the evaluation. Data collection began after both plans had been reviewed and subsequently approved by the Evaluation Subcommittee and the project’s partners.

An Interim Evaluation Report was developed in March 1999 to address evaluation Goal 3: "*Assess the institutional impacts of the Showcase Program.*" The findings from that report are included again here for completeness.

1.3 Organization of this Report

This InterCAD Evaluation Report provides a background description of the Southern California Priority Corridor and the project-related transportation challenges facing San Diego County. This is followed by descriptions of the Showcase Program and the InterCAD project, including a detailed technical description. The evaluation itself is subdivided and ordered into the four topic areas (corresponding to the evaluation goals) described below:

System Performance — provides important benchmark information regarding system availability, reliability, scalability and compatibility. The evaluation quantifies those items and could be used to identify needed improvements and help develop specifications for future systems. The InterCAD project predates many other Showcase activities, particularly those related to the development of the Showcase Network and supporting servers and communications systems. A timeline of InterCAD activities compared with Kernel development activities can be found in Exhibit 10.

Cost — provides important benchmark information regarding funding sources, software licensing, development costs, and costs to re-deploy elsewhere or expand the system. Operations and Maintenance costs will not be addressed since the InterCAD system (though tested for operational integrity as required contractually) did not become fully operational with all participants. Potential reasons for InterCAD's current operational status are explored in the section on Institutional Issues and Impacts

Institutional Issues and Impacts — provides important information regarding the administrative, procedural and legal impacts resulting from the deployment of InterCAD. This section will be the focal point of this report. Such impacts include changes in program and project communications procedures, agency responsibilities, as well as changes and limitations of agency-wide policies, procedures and guidelines.

Transportation & Traveler Information Management — provides important benchmark information on system usage and user acceptance (by both agency operators and the general public). This report provides qualitative findings on those items and can be used to identify user demand, needed improvements and potential areas of future growth. Quantitative data was not collected due to the non-operational status of the InterCAD system.

Transportation System Impacts — provides important information regarding impacts on transit usage, traffic congestion, air quality, and traffic safety. As of the writing of this report, the InterCAD system has not been in use since the testing phase; therefore, this goal will not be addressed in this report.

The report includes a summary, final remarks and recommendations for next steps. Several appendices contain supporting documentation such as technical designs and copies of evaluation data collection instruments (blank questionnaires and survey).

1.4 Privacy Considerations

Some of the information acquired in the interview and discussion process could be considered sensitive and has been characterized in this report without attribution. The Evaluation Team has taken precautions to safeguard responses and maintain their confidentiality. Wherever possible, interview responses have been aggregated during analysis such that individual responses have become part of a larger aggregate response. The names of individuals and directly attributable quotes have not been used in this document unless the person has reviewed and expressly consented to its use.

1.5 Constraints & Assumptions

The InterCAD project evaluation is subject to the following constraints and assumptions:

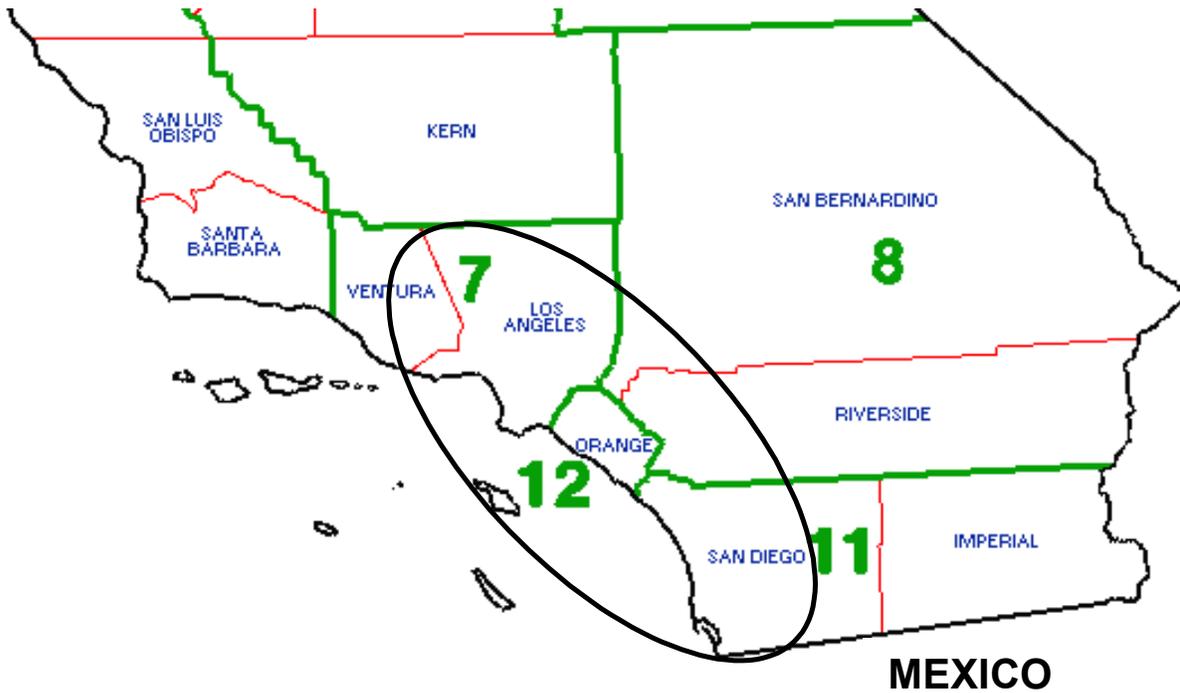
- ▶ The project's consultant was not required to disclose actual project expenses, so the project's cost is based on the fixed-price budget stipulated in the InterCAD contract and its amendments. The budget reflects the expenses and costs for services paid by the client agency, but not necessarily the actual detailed costs for goods and services comprising the project.

1.6 Project Background

1.6.1 The Southern California Priority Corridor

In 1993, the U.S. Department of Transportation designated Southern California as one of four Priority Corridors in which Intelligent Transportation Systems (ITS) could have particular benefit. Southern California suffers from extreme traffic congestion, limited room for expanding transportation facilities, and above-average air pollution levels. The Southern California Priority Corridor, illustrated in Exhibit 2, is one of the most populated, traveled, and visited areas in the country.

Exhibit 2 – The Southern California Priority Corridor and Vicinity



The Southern California Priority Corridor consists of four distinct regions that correspond with the four Southern California Caltrans districts:

- ▶ Los Angeles/Ventura (Caltrans District 7)
- ▶ Orange County (Caltrans District 12)
- ▶ San Diego County (Caltrans District 11) (Location of the InterCAD Phase II project)
- ▶ Inland Empire (Caltrans District 8).

Roughly two-thirds of the state’s population – about 20 million people – resides in or around the Southern California Priority Corridor.

Exhibit 3 – Population and Number of Registered Vehicles by County

County	Population ² (as of 7/1/2001)	Registered Vehicles ^{3*} (as of 12/31/2000)	Caltrans District
Los Angeles	9.7 million	6.2 million	7
Orange	2.9 million	2.1 million	12
San Diego	2.9 million	2.1 million	11
San Bernardino	1.8 million	1.1 million	8
Riverside	1.6 million	1.1 million	8
Ventura	0.8 million	0.6 million	7
Imperial	0.15 million	0.1 million	11
Total	19.85 million	12.7 million	

*Includes autos, trucks, and motorcycles. Trailers not included.

1.6.2 The Southern California Priority Corridor's ITS Showcase Program

The ITS Showcase Program is one of several programs that have been implemented in Southern California's Priority Corridor to help aid mobility and mitigate traffic congestion and its associated environmental impacts.

The Southern California ITS Showcase Program consists of 17 individual ITS projects that collectively form a corridor-wide intermodal transportation management and information network between Los Angeles, Orange County, San Diego, and the Inland Empire. Eleven of the projects are regional in nature, while the remaining six are corridor-wide in scope. San Diego County's InterCAD project is one of the eleven regional projects.

The 17 Showcase projects are listed by region in Exhibit 4. Eight of the projects, including InterCAD, were fast-tracked and designated "Early Start" projects because of their importance as base infrastructure and their potential to act as role models for the rest of the Showcase Program.

Exhibit 4 – The 17 Showcase Projects and their Status as of March 2003

Project	RFP Issued	Contractor Selected	Contract Executed	Project Underway	Project Complete
Corridor-wide					
Scoping & High Level Design*	✓	✓	✓	✓	✓
Strategic Planning/Systems Integration	✓	✓	✓	✓	✓
CVO ¹					
ATIS	✓	✓	✓	✓	✓
ATMS ¹					
Rideshare	✓	✓	✓	✓	✓
Los Angeles Region					
IMAJINE*	✓	✓	✓	✓	✓
Mode Shift*	✓	✓	✓	✓	
LA ATIS	✓	✓	✓	✓	
Inland Empire Region					
Fontana-Ontario ATMIS	✓	✓	✓	✓	
Orange County Region					
TravelTIP*	✓	✓	✓	✓	✓
OCMDI	✓	✓	✓	✓	✓
San Diego Region					
InterCAD*	✓	✓	✓	✓	✓
Mission Valley ATMIS*	✓	✓	✓	✓	
IMTMS/C (ATMSi)*	✓	✓	✓	✓	
Traffic Signal Integration (RAMS)	✓	✓			
Transit Management System*	✓	✓	✓	✓	

* Indicates an "Early Start" project.

¹ CWCVO and CWATMS do not yet have approved workplans.

InterCAD was a Showcase Early Start Project, and was designed to facilitate improved incident management in San Diego County's portion of the Priority Corridor. The overall InterCAD project goal was to automatically exchange incident-related data in near real-time to avoid dependence on telephone coordination among local agencies. InterCAD planned to be the first operational Showcase project, and was envisioned to lead to eventual implementation in multiple regions of the corridor.

The project consisted of two phases. Phase I included a concept demonstration and feasibility analysis in cooperation with three law enforcement agencies: San Diego Police Department (SDPD), the San Diego Sheriff's Office (SDSO), and the California Highway Patrol (CHP) Border Division. Phase I was funded by local funds and the Service Authority for Freeway Emergencies (SAFE). SAFE contributed funding from its operating reserves to complete Phase I of the InterCAD San Diego project in 1996. Phase II of the InterCAD project commenced shortly after the completion of Phase I, and entailed an expansion and demonstration of the Phase I capabilities. Phase II of the project was funded by the Showcase Program and expanded the Phase I participation to include eight more emergency response, fire, and law enforcement agencies. However, only the following five agencies ultimately participated in the Phase II operational test:

- ▶ Caltrans District 11 Transportation Management Center (TMC)
- ▶ Federal Fire Department
- ▶ Heartland Communications
- ▶ California Department of Forestry/Cleveland National Forest.

Please note that California Department of Forestry (CDF) and Cleveland National Forest (CNF) are separate agencies, but are co-located and share dispatch and operations facilities.

Phase II of the InterCAD project was funded using federal funds under the Southern California Priority Corridor Showcase Program in conjunction with a local match. Phase II intended to exchange data using ten standardized message types. The InterCAD system essentially provided a fast electronic mail for rapid coordination of interagency response to multi-jurisdictional incidents. InterCAD was designed to work with any CAD system and used a defined set of messages that all CAD systems could be programmed to read or send. Phase II also intended to integrate InterCAD to the Showcase Network via the San Diego Kernel when this capability was made available. The Kernels and Showcase Network were being developed as part of Showcase's Scoping & Design project.

Exhibit 5 shows the agencies planned to be involved in each phase of the project. Only those agencies shown in bold actually participated in the project. Law enforcement agency participation in Phase II has been delayed and is further discussed in the following sections.

The type of software to be used to provide the appropriate InterCAD capability is shown in parentheses next to the agency name. The acronym "IMX" stands for InterCAD Message Exchange terminal, which is a stand-alone InterCAD software/hardware solution. "Organic" indicates software that is integrated into the agency's pre-existing CAD system. Both of these

solutions also include ancillary hardware and are described in detail in the Project/System Description section.

Exhibit 5 – Planned Participating Agencies by InterCAD Phase

InterCAD Phase II Agencies	
InterCAD Phase I Agencies	<ul style="list-style-type: none"> ▪ San Diego Fire Department (Organic)
<ul style="list-style-type: none"> ▪ California Highway Patrol (Organic) ▪ San Diego Police Department (Organic) ▪ San Diego Sheriffs Department (IMX) 	<ul style="list-style-type: none"> ▪ North County Fire Joint Powers Agency (Organic) ▪ California Division of Forestry and Cleveland National Forest (co-located) (IMX) ▪ Oceanside Police Department & Fire Department (IMX) ▪ Federal Fire Department (IMX) ▪ Heartland Communications Agency (Organic) ▪ California Department of Transportation (District 11) (IMX)

2 Project/System Technical Description

2.1 *Project/System Description*

The objective of this interagency connectivity project was to establish a screen-to-screen operator interface among the participating agencies using advised incident record and free text message formats. Messages were to be pushed out to an external network by the originating agency, so that they could be voluntarily retrieved by the recipient agency.

The InterCAD system provides two different messaging system solutions to participating agencies depending on whether or not the InterCAD capability would be integrated with an existing agency CAD system.

As originally intended, if an agency CAD system existed and was available for InterCAD integration, then the IBM Message Queue Manager (MQM) software or “middleware” was to be installed on a PC or workstation message server and connected to the agency’s CAD system. The message server performed message management and wide area network communications functions. Each CAD system’s attached message server ran a customized version of MQM software configured to talk to the agency’s CAD computer. In general, messaging was intended to occur across a secure wide-area sub-network. InterCAD planned the use of a leased data service for its wide area network (WAN) provided by Pacific Bell’s Switched Multi-megabit Data Service (SMDS). InterCAD SMDS operated, at that time, at 56 Kbps. InterCAD used the IBM MQ series message system to connect dissimilar CAD systems. The common InterCAD message standard permitted each agency to use its unique format internally, while communicating incident management information with other agencies. Each agency translated the InterCAD message into its internal format for display on the local CAD system. This integrated, “Organic” solution was demonstrated at Heartland Communications.

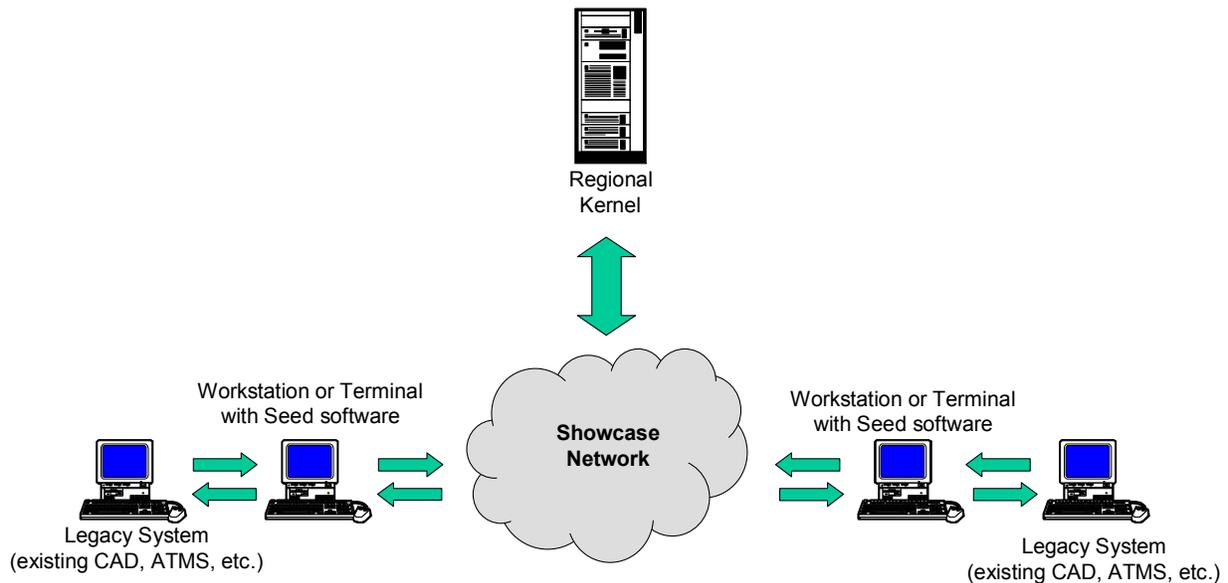
If no CAD system was available for integration to the InterCAD capability, which was the case with most of the participating agencies, then an InterCAD Message Exchange (IMX) terminal was provided to function either as a stand-alone terminal or as a node on the agency’s local area network. A local area network connection permitted cut and paste of data from the local system to an InterCAD message, which eliminated re-typing of incident information. For local agencies undergoing CAD system replacements, IMX also provided the InterCAD capability while the new system was brought on-line and an integrated InterCAD capability was developed for the new CAD system software.

InterCAD is considered a legacy system by Showcase, which in itself develops a form of middleware for integrating a diverse array of systems throughout the Southern California Priority Corridor. Showcase institutes standard protocols and interfaces, as well as the hardware and software necessary to implement these interfaces and manage the interregional Showcase Network. Exhibit 6 shows the Showcase Architecture’s Kernel-Seed concept. This architecture enables a legacy system to continue to use its native data format while also exchanging that data with dissimilar systems through the use of a translator. This data translation is the function of “legacy bridges,” which Showcase refers to as “Seeds.” Each Seed is customized to translate

and convert its legacy system's unique data structures into Showcase's standard objects for delivery to another system, while also converting incoming Showcase objects back into the native data format.

The interregional or corridor-wide Showcase Network provides the physical data communications connection between the four Southern California regions. Four Kernel servers (one in each region) manage and provide access to the network. Centers must log in to one of these servers in order to join the network and begin sharing data.

Exhibit 6 – The Showcase Architecture's Kernel-Seed Concept

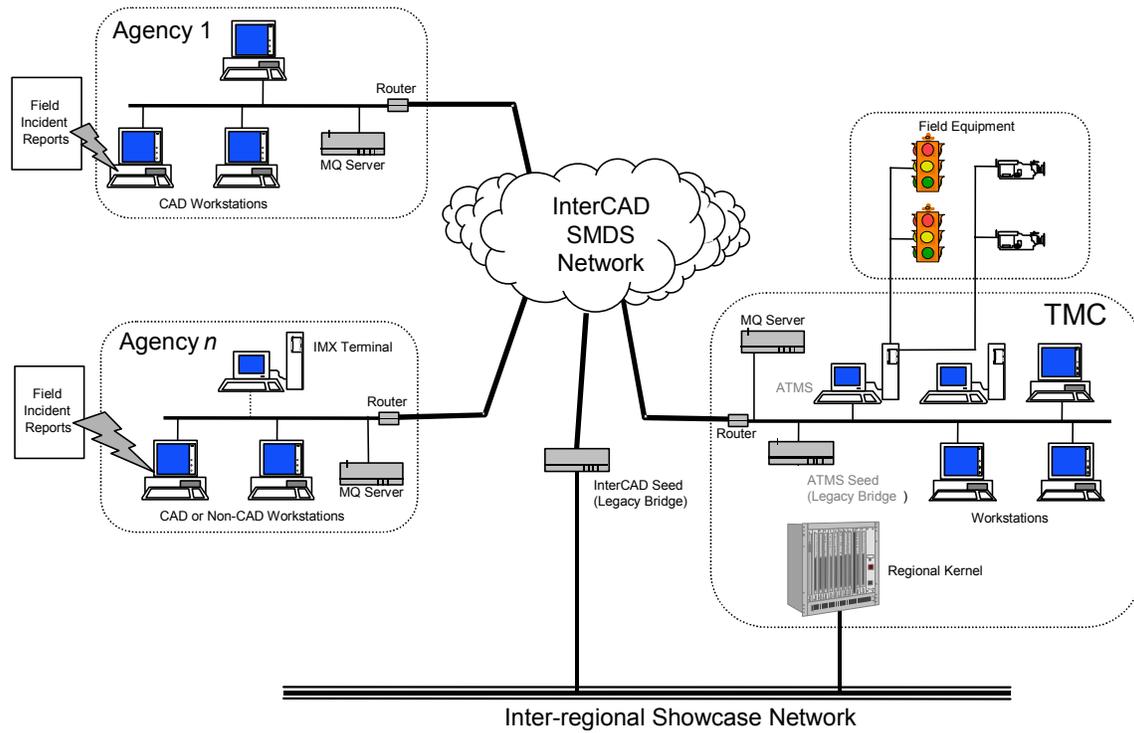


A legacy bridge or “Seed” was to be developed as part of the InterCAD project to connect the InterCAD network to the Priority Corridor’s Showcase Network. The Seed uses the InterCAD message oriented middleware protocol on the InterCAD network side, and the Showcase Object-Oriented peer-to-peer protocol on the Showcase Network side, with object definitions provided by Showcase’s Scoping & Design project.

Once the Seed or interface to the Showcase Network was implemented, and the Kernel was available, the InterCAD system planned to connect transportation management systems to the Showcase Network. The system was intended to have access to relevant messages sent from any InterCAD connected agency, and be able to report transportation system related information to these agencies. The InterCAD Seed would filter and pass permitted incident messages from the InterCAD network to the interregional Showcase Network, and ultimately on to those agencies in the Corridor requesting to receive such information. Also, the Seed would pass messages to InterCAD in the InterCAD standard message format, and only to InterCAD-connected host systems. This was an important feature for maintaining the security and confidentiality of the host network and connected agencies.

Exhibit 7 is a high level depiction of both the MQ server and IMX terminal solutions. Agency *n* depicts a CAD system that is not capable of incorporating the Organic InterCAD solution, or an agency where no CAD system is available.

Exhibit 7 – High-level InterCAD System Schematic



3 System Performance Evaluation

3.1 The Project/System Development Process and Timeline

InterCAD is the culmination of roughly seven years of effort. An initial RFP was issued for Phase I in 1996. The Phase II RFP, the phase funded by Showcase, was issued in 1997. InterCAD is primarily a software development and systems integration project. The project tasks, associated deliverables and delivery dates are shown in Exhibit 8.

Exhibit 8 – InterCAD Project Tasks and Deliverables

InterCAD Phase II Project Task		Deliverable(s)	Delivery Date(s)/ Comments
Task 1.1	Regional Task Force Management	Monthly Report(s) - including monthly agenda and minutes for Regional Task Force, project financial status and project schedule status Quarterly Newsletter(s)	January 1997 Thru January, 2000
Task 2.1	Identify Other Incident Management Participants	Technical Memorandum - Survey of Area CAD Systems and Agency Responsibilities	October 1997 thru October 1999
Task 2.2	Support Showcase Kernel High Level Design	Technical Memorandum - TMC/InterCAD Seed Requirements	May 1997 thru October 1997
Task 2.3	Support Kernel System Requirements Definition	Included in Task 2.2	N/A
Task 2.4	Develop Release 2.0 Operational Requirements	Technical Memorandum - InterCAD Release 2.0 Operational Requirements	October 1997
Task 2.5	Develop Release 2.0 Functional Requirements	Technical Memorandum - InterCAD Release 2.0 Functional Requirements	October 1997
Task 2.6	Develop Release 2.0 High-Level Hardware and Software Design	Technical Memorandum - InterCAD Release 2.0 High-Level Hardware and Software Design	January 1998
Task 2.7	Develop TMC Interface	(Supplier – Odetics and NET – Task included in the Showcase Kernel Prototype)	N/A
Task 2.8	Develop TMC MQM Server and InterCAD Seed	(Suppliers – AST, IBM, T-Cubed) 2.8a Server hardware (AST) 2.8b MQM Series Server software 2.8c Integration support (T-Cubed) 2.8d TMC InterCAD Seed	September 1997
Task 2.9	Develop Other Agency CAD Interfaces and MQM Servers	(Supplier - IBM) 2.9a MQ Series software 2.9b Site customization 2.9c CAD interface	May 1999 thru February 2000

InterCAD Phase II Project Task		Deliverable(s)	Delivery Date(s)/ Comments
Task 2.10	Expand Wide Area Network	Technical Memorandum - Regional and Interregional WANs: Technical, Management and Cost Analysis	December 1997
Task 2.11	Develop Incremental Software Release 2.0	(Supplier - CAD system developers) 2.11a CAD software (PRC) 2.11b CHP software modifications (?) 2.11c CAD software (American TriTech) 2.11d CAD interface (Federal Fire)	October 1999 thru April 2000
Task 2.12	Release 2.0 Integration and Testing	(Supplier - Participating agencies and CAD system developers) Application Level Test	October 1999 thru April 2000
Task 2.13	System Installation	(Supplier - Participating agencies and CAD system developers) 2.13a Server hardware 2.13b MQ software 2.13c Hardware installation support 2.13d SMDS network installation 2.13e SMDS recurring charges 2.13f Network hardware 2.13g Site configuration 2.13h Install network connectivity 2.13i Network sniffer 2.13j System administrator familiarization	November 1997 thru April 2000
Task 2.14	Operational Demonstration of Regional Public Safety Network/TMC Connectivity and Multi-Agency Incident Management	(Supplier - Participating agencies and CAD system developers) Included in Task 2.11	August 1999 thru April 2000
Task 2.15	Develop Priority Corridor Message Standard Management Guidelines	Technical Memorandum - InterCAD Message Standard Management Guidelines	December 1997
Task 2.16	Prepare Phase 2 Final Report	InterCAD San Diego Phase 2 Final Report	November 2000
Task 2.17	Conduct System Training	(Supplier - IBM)	February 2000
Task 2.18	System Quality Assurance and Certification	Technical Memorandum - Phase 2 Certification Test Plan	February 2000
Task 2.19	Evaluation Support	Technical Memorandum - InterCAD Evaluation Support Plan	February 1998

InterCAD Phase II Project Task		Deliverable(s)	Delivery Date(s)/ Comments
Task 2.20	Outreach Liaison (New Task)	InterCAD Outreach package to include program description, briefing visuals, agency presentations and a "blueprint" package detailing the technical requirements for InterCAD participation.	February 2000

The fixed-price InterCAD Phase II contract initially specified an 18-month period of performance; however, several factors contributed to a relatively elastic timeline that included periods of inactivity so as to preserve the project budget. These factors include:

- ▶ Delays in Kernel development
- ▶ Delays by IBM in providing patches to the MQ Server software
- ▶ Changes in participant CAD systems and computer hardware
- ▶ Moves/relocations of agency facilities

Thus the overall period of performance was extended several years beyond the originally intended year-and-a-half. However, the project contractor indicates that this overall time frame does not necessarily reflect the total cumulative time to conduct project tasks. The project contractor also indicated that additional resources and labor were dedicated to the project in excess of the project budget in order to bridge the gaps in activity and make up for unforeseen institutional challenges.

3.2 System Reliability, Availability, Compatibility, and Scalability

3.2.1 System Reliability and Availability

During operational testing of the InterCAD message exchange capability, there was no evidence of any system failures.

The InterCAD system was tested between four participating agencies and test messages continued to be pushed out by Caltrans District 11 TMC for a short term in late 1999. The continuation of test messages was intended to assist participating agencies in becoming familiar with and accustomed to using the InterCAD system. During this test period, there was no evidence of any system failures.

3.2.2 Compatibility

The basic premise of InterCAD was to circumvent any compatibility conflicts by designing a solution that could be integrated into any CAD system through minor modifications of the InterCAD software rather than the participating agency's CAD system.

Compatibility is the ability of two or more systems or components to perform their required functions while sharing the same hardware or software environment. During the test period described, there were no system failures or anomalies experienced by the users that would indicate an incompatibility with the existing software or hardware environment. Some agency legacy CAD systems were not capable of integrating the Organic InterCAD solution, thus the need for the stand-alone IMX system.

3.2.3 Scalability

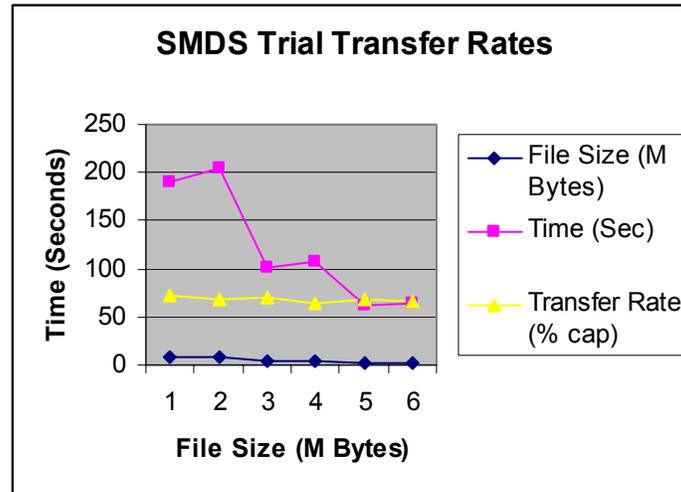
The distributed design of the InterCAD system does not constrain the scalability of the system.

Scalability describes the extent to which system usage can grow without sacrificing system performance or requiring architectural or technology changes. InterCAD is a distributed system, so the scalability of the InterCAD system is primarily constrained by the capacity of the SMDS network to handle the exchanged messages between participating agencies. In other words, since each agency has its own hardware for message processing, and the message processing software resides in the agency terminals, the network between the agencies is the only remaining constraint.

The SMDS network is a leased network. The available bandwidth of the SMDS network can be increased through purchase of additional capacity as the system is expanded. The selected SMDS network had a capacity of 56Kbps. However, up to 45 Mbps capacity was available if needed. If a participating agency required additional capacity, this capacity could be purchased at any time. A change in the entire network capacity was not necessary for individual customization of capacity.

Typically, the time to transfer the packets of data that comprise a file can be expressed as a function of percentage of the capacity of the network. The following graph illustrates transfer rate scenarios for files of 2.7MB to 8.8MB in size. The rate of change in transfer time remains relatively stable as the file size increases. Therefore, for the purposes of InterCAD's use in the San Diego domain, no perceptible drop in performance would be expected with the addition of nodes on the network up to and including expansion phase agencies.

Exhibit 9 – SMDS Performance Indicator as Trial Transfer Rates⁴



3.3 Impact of Showcase Integration on Project Deployment and System Performance

InterCAD is one of 17 projects that make up the Showcase Program and Network. Additionally, InterCAD is one of five regional Showcase projects in the San Diego region. As such, many interdependencies developed between the InterCAD project and the development of the Showcase Kernel as plans were made for eventual regional and corridor-wide integration. This section describes how these interdependencies impacted InterCAD and other Showcase projects.

3.3.1 Impact of InterCAD on other Showcase Projects

InterCAD predated most Showcase activities; therefore, there was little impact or influence on other Showcase projects.

The Early Start projects were originally intended to provide a rapid demonstration of the Showcase Program concepts and help maintain momentum for continued support of the overall program. InterCAD was the first Showcase Early Start project to reach testing; however, as explained in more detail below, a regional Kernel was not available for InterCAD to integrate to the Showcase Network.

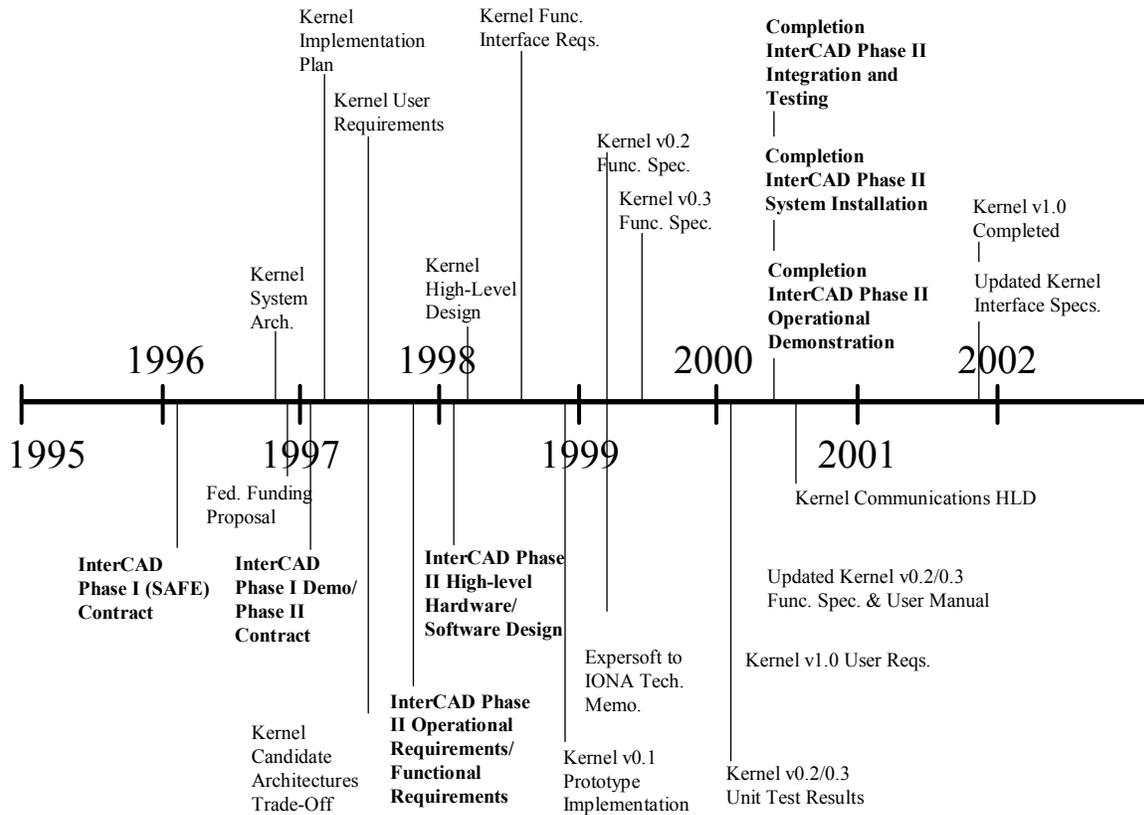
3.3.2 Impact of other Showcase Projects on InterCAD

InterCAD was the first Showcase project to reach the testing phase; however, this phase predated Kernel completion by more than a year.

Delays in completion of the Kernel prohibited InterCAD from integrating with the Showcase Network and exchanging data interregionally during Phase II, so this work will be completed under a future project. However, the InterCAD Phase II system was designed such that project participants were still able to communicate through the SMDS intranet set up specifically for them.

Exhibit 10 illustrates the parallel development of InterCAD Phase II and the Showcase Kernel.

Exhibit 10 – Joint Timeline of the InterCAD and Kernel Early Start Project



Original completion of InterCAD Phase II was expected in December 1998, however, participating agency readiness and other institutional issues slowed progress. Participant delays were largely based on either changes/upgrades to the participant’s current CAD system, operations facility relocation, upgrades/changes to computer system hardware, or security concerns based on centralized agency policy.

4 Cost Evaluation

The information contained in this cost evaluation has been obtained from documented costs and personal interviews. Budget information was taken directly from the project's contract and amendments. No operations and maintenance costs are available at this time due to a brief operational test and the currently idle status of the InterCAD system. Informal interviews were conducted to verify information and supply any missing information identified during analysis.

4.1 *Constraints & Assumptions*

There are two primary considerations for the Cost Evaluation:

- ▶ Since InterCAD was funded through a firm fixed price contract, the project's budget information reflects the expenses and costs for services paid by the client agency, but not necessarily the actual detailed costs for goods and services comprising the project.
- ▶ Operations and maintenance (O&M) costs are not applicable due to the idle status of the InterCAD system.

4.2 *Project Budget & Estimated Development Costs*

Approximately \$681,000 was made available for the InterCAD Phase II contract. Exhibit 11 lists the project's 21 tasks and the budget associated with each one, as agreed to in the initial contract and subsequent contract amendments. More detail regarding each task is provided below. Since the project was negotiated as a fixed-price contract, the budgets shown in Exhibit 11 do not reflect actual costs for services rendered. Project contractors indicate that additional labor and resources were applied over and above the allocated budget so that unforeseen delays and institutional issues could be overcome to bring the project to completion. The system developer's estimate of additional unbudgeted costs for InterCAD Phase II is approximately \$127,000.

Exhibit 11 – InterCAD Phase II Project Budget per Task⁵

InterCAD Phase II Project Task	Final Budget	Final %
Task 1.1 Regional Task Force Management	\$19,600	2.9%
Task 2.1 Identify Other Incident Management Participants	\$18,750	2.8%
Task 2.2 Support Showcase Kernel High Level Design	\$15,000	2.2%
Task 2.3 Support Kernel System Requirements Definition	\$0	0.0%
Task 2.4 Develop Release 2.0 Operational Requirements	\$5,000	0.7%
Task 2.5 Develop Release 2.0 Functional Requirements	\$22,000	3.2%
Task 2.6 Develop Release 2.0 High-Level Hardware and Software Design	\$22,000	3.2%
Task 2.7 Develop TMC Interface	\$0	0.0%
Task 2.8 Develop TMC MQM Server and InterCAD Seed	\$68,160	10.0%
Task 2.9 Develop Other Agency CAD Interfaces and MQM Servers	\$51,500	7.6%
Task 2.10 Expand Wide Area Network	\$12,000	1.8%
Task 2.11 Develop Incremental Software Release 2.0	\$258,000	37.9%
Task 2.12 Release 2.0 Integration and Testing	\$6,000	0.9%
Task 2.13 System Installation	\$125,990	18.5%
Task 2.14 Operational Demonstration of Regional Public Safety Network/TMC Connectivity and Multi-Agency Incident Management	\$0	0.0%
Task 2.15 Develop Priority Corridor Message Standard Management Guidelines	\$8,000	1.2%
Task 2.16 Prepare Phase 2 Final Report	\$12,000	1.8%
Task 2.17 Conduct System Training	\$15,000	2.2%
Task 2.18 System Quality Assurance and Certification	\$8,000	1.2%
Task 2.19 Evaluation Support	\$8,000	1.2%
Task 2.20 Outreach Liaison (New Task)	\$6,000	0.9%
Total	\$681,000	100%

Exhibit 12 – Distribution of InterCAD Budget by Task

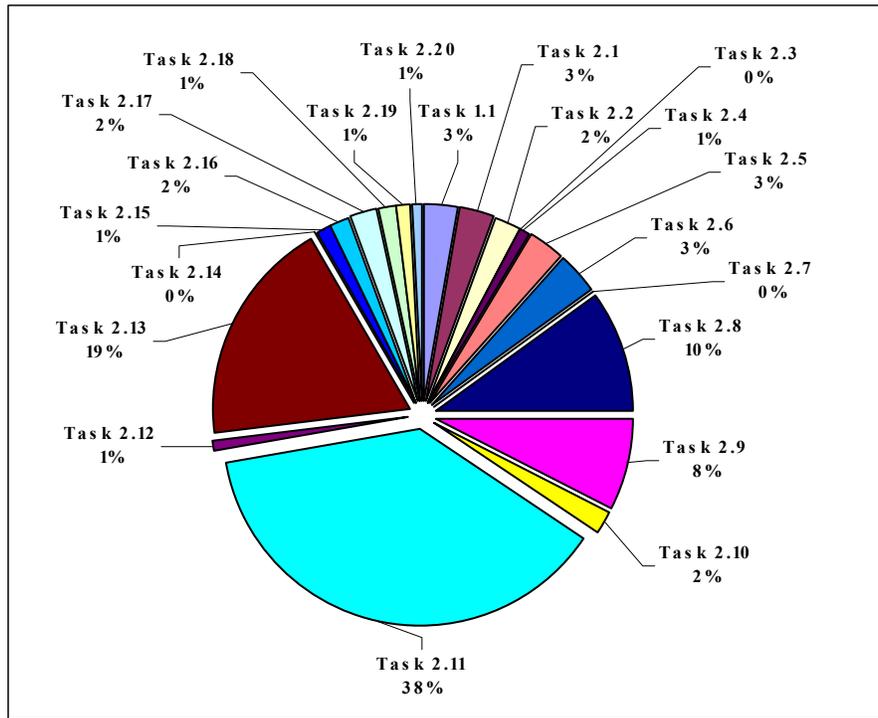


Exhibit 13 shows that the InterCAD system consists of the following hardware:

Exhibit 13 – InterCAD System Hardware and Supporting Items

Task	Hardware Item	Unit Cost*	Total Cost*
2.8a	TMC MQMServer hardware (AST)	\$6,000	\$6,000
2.13a	Agency MQM Server hardware (AST) (5)	\$6,000	\$30,000
2.13f	Network hardware (9)	\$3,388	\$30,492
2.13g	Site configuration (9)	\$3,600	\$32,400
2.13i	Network sniffer	\$500	\$500
	Total		\$99,392

*Cost at time of purchase in 1997

The largest share of costs for the InterCAD project consisted of software development and commercial off the shelf (COTS) software purchases. The following table outlines the primary software development and purchase costs for the InterCAD project.

Exhibit 14 – InterCAD System Software and Supporting Items

Task	Software Item	Unit Cost	Total Cost
2.8b	MQM Series Server software (IBM)		\$1,500
2.8c	Integration support (T-Cubed)		\$10,660
2.8d	TMC InterCAD Seed		\$44,000
2.9a	MQ Series software	\$1,500	\$7,500
2.9b	Site customization	\$1,000	\$5,000
2.9c	CAD interface	\$6,500	\$39,000
2.11a	CAD software (PRC)		\$115,000
2.11b	CHP software modifications		\$35,000
2.11c	CAD software (American TriTech)		\$100,000
2.11d	CAD interface (Federal Fire)		\$8,000
2.13b	MQ software (IBM)	\$1,500	\$7,500
	Total		\$373,160

In summary, software development and supporting activities accounted for 57.5% of the total project budget. Hardware procurement and installation accounted for 14.6% of the total project budget. The remaining 27.9% of the budget was allocated for research, training, documentation, project management, and other project support activities.

4.3 Estimated Operations & Maintenance Costs

InterCAD Phase II was tested between four participating centers using PacBell's SMDS network. Had the system continued to be operated using this service, the estimated total annual O&M cost might have been \$18,889.

4.2.1 Operations

The operations cost for InterCAD has been broken down into two contributing components: labor costs and utility costs. Each of these components is estimated below.

4.2.1.1 Labor

InterCAD would not be expected to increase nor decrease labor costs. The system was designed to improve the transfer of time-critical and incident-related information between existing operator positions within the participating agencies' communication centers, thus not requiring any new or additional operators that would increase labor costs. Also, since the system was not intended nor designed to run autonomously without human oversight, no savings to labor costs would be anticipated.

4.2.1.2 Utilities

The utility costs that are most attributable to the InterCAD system are electricity (for powering the IMX terminals) and telecommunications (for interagency communications). Exhibit 15 estimates the annual electricity cost impact that could be produced by InterCAD hardware. These estimates are based on the following assumptions:

- ▶ An average electricity rate of \$0.16 per kW-hour (the actual rate varies seasonally)
- ▶ Terminals and monitors operate 24 hours per day, 7 days per week, 52 weeks per year

Exhibit 15 – Estimated Marginal Annual Electricity Costs for InterCAD

Hardware Item	Model	Power Draw	Power Cost	Est. Annual Cost
6 MQM Servers/IMX Terminals	Sun Ultra 5/10	250W ea.	\$0.16/kW-hr	\$2097
6 typical 21" color monitors	Various	135W ea.	\$0.16/kW-hr	\$1132
				\$3229

As previously described, InterCAD’s telecommunications needs are provided by PacBell’s leased 56 Kbps SMDS network:

Exhibit 16 – Monthly and Annual Telecommunications Costs

Description	One-time Installation Fee	Ongoing Monthly Cost	Ongoing Annual Cost
Leased 56Kbps data connection.	\$10,768	\$1305	\$15,660

Exhibit 17 combines the estimated annual costs for electricity (from Exhibit 15) and telecommunications (from Exhibit 16) to arrive at an estimated total annual utility cost for InterCAD.

Exhibit 17 – Total Estimated Annual Marginal Cost for Operating InterCAD

Cost Component	Est. Annual Marginal Cost
Electricity	\$3229
Telecommunications	\$15,660
TOTAL	\$18,889

5 Institutional Impacts Evaluation

The InterCAD Institutional Issues Evaluation relies primarily on qualitative data. For this part of the evaluation, interviews were conducted with participating agency management and other supporting staff. These interviews were supplemented by formal and informal discussions with the agency's management and staff at both regular project meetings as well as private meetings. Each of these interviews or discussions has aided the evaluator in piecing together the issues that have had an impact on the project.

The purpose of this section is to document and discuss institutional issues identified during this evaluation activity. The section begins with a discussion of communication methods currently used by the emergency response and law enforcement agencies of the region. This inter-agency communications discussion will frame the current communications procedures, the expected changes in communications capability intended with full utilization of the InterCAD system, and some of the associated observations regarding the role of project partners in regional incident management and response.

Issues in this section include both those related to InterCAD Phase II project participant relationships as well as the relationship of the InterCAD Phase II project to other Showcase projects. InterCAD was not connected to the Showcase Network during the life of the project; therefore, limited information exists regarding the impacts of InterCAD on other Showcase projects. Comments included in this section regarding Phase I of the InterCAD project are included for context purposes only.

5.1 *Inter-Agency Communications*

Exhibits 18 and 19, respectively, indicate where inter-agency communications are currently occurring and where they were expected to occur after Phase II of the InterCAD project became operational. The contents of the interior cells indicate the status of communications between the two agencies aligned on the matrix. In other words, a “no” indicates “no formal, consistent communication channel or method has been established; a “yes” indicates a formal and consistent communication method is used; an “indirect” indicates communication through a third party agency or some other indirect method; if there are circumstances or special conditions surrounding the communication between the initiating and receiving agencies, this is indicated by referral to a notes section following the two matrices. Currently, data security concerns of the Phase I law enforcement agencies have delayed their participation in the InterCAD Phase II project. Other participating agencies have not yet made the InterCAD system part of their daily operational procedures.

Please see the notes following the matrices for further explanation and information.

Exhibit 18 – Inter-Agency Communications Matrix for Incident Response (Pre-InterCAD Phase II)

	Caltrans	CDF	CNF	Federal Fire	Heartland	CHP (See Note 6)	SDPD	Sheriff
Caltrans		No	No	See Note 8	See Note 8	Yes, co-located	Indirect comm. only, via CHP	Yes, via ring-down line
CDF	Indirect comm. only, via CHP		Yes, co-located	Yes, To borrow crash truck, otherwise See Note 8	Yes, Ring down line	Yes, telephone	See Note 8	See Note 8
CNF	Indirect comm. only, via CHP	Yes, co-located		See Note 8	Yes, Ring down line	Yes, telephone	See Note 8	See Note 8
Federal Fire	See Note 8	See Note 8	See Note 8		See Note 8	See Note 8	See Note 8	See Note 8
Heartland	See Note 8	Yes, Ring down line	Yes, Ring down line	See Note 8		See Note 8	See Note 8	See Note 8
CHP (See Note 6)	Yes, co-located	Yes	Yes	See Note 8	See Note 8		Yes, via common WAN & wireless networks, ARJISnet, ring down line	Yes, via common WAN & wireless networks, ring down line
SDPD	Indirect comm. only, via CHP	See Note 8	See Note 8	See Note 8	See Note 8	Yes, via common WAN & wireless networks, ring down line		Yes, via common WAN & wireless networks, ring down line
Sheriff	Yes, Ring-down line	See Note 8	See Note 8	See Note 8	See Note 8	Yes, via common WAN & wireless networks, ring down line	Yes, via common WAN & wireless networks, ARJISnet, ring down line	

Exhibit 19 – Inter-Agency Communications Matrix for Incident Response (Post-InterCAD Phase II)

	Expected operational	Caltrans	CDF	CNF	Federal Fire	Heartland	CHP (See Note 7)	SDPD (See Note 7)	Sheriff (See Note 7)
Caltrans	5/99		See Note 5	See Note 5	See Note 5	See Note 5	Yes, co-located	Indirect comm. only, via CHP	Yes, via ring-down line
CDF	5/99	See Note 5		See Note 5	See Note 5	See Note 5	Yes, telephone	See Note 8	See Note 8
CNF	5/99	See Note 5	See Note 5		See Note 5	See Note 5	Yes, telephone	See Note 8	See Note 8
Federal Fire	5/99	See Note 5	See Note 5	See Note 5		See Note 5	See Note 8	See Note 8	See Note 8
Heartland	5/99	See Note 5	See Note 5	See Note 5	See Note 5		See Note 8	See Note 8	See Note 8
CHP (See Note 7)	NA	Yes, co-located	Yes	Yes	See Note 8	See Note 8		Yes, via common WAN & wireless networks	Yes, via common WAN & wireless networks
SDPD (See Note 7)	NA	Indirect comm. only, via CHP	See Note 8	See Note 8	See Note 8	See Note 8	Yes, via common WAN & wireless networks		Yes, via common WAN & wireless networks
Sheriff (See Note 7)	NA	Yes, Ring-down line	See Note 8	See Note 8	See Note 8	See Note 8	Yes, via common WAN & wireless networks	Yes, via common WAN & wireless networks	

Notes to Exhibits 18 and 19

1. These matrices indicate the current and expected inter-agency communication arrangements between participating InterCAD Phase II agencies (white cells) and Phase I agencies (dark gray cells). Where indicated, Phase I agencies act as coordinator for Phase II agencies.
2. These matrices refer to the initiation of communications. Initiating agencies are listed in the left-hand column. Receiving agencies are listed in the top row.
3. It is noted that each agency's jurisdiction has a different geographic coverage:
 - Caltrans District 11 covers freeways and state highways in the counties of San Diego and Imperial Valley
 - California Department of Forestry and Fire Protection (CDF) provides fire protection and stewardship to 31 million acres of California's privately owned 'Wild Land', and varied emergency services in 34 of the State's 58 counties via contract with local governments. In the context of InterCAD, CDFs jurisdiction within San Diego County will be the domain for the inter-agency messaging.
 - Cleveland National Forest (CNF) is a U.S.D.A. Forest Service unit, located either side of I-15 from southern Orange County, south-west Riverside County, through San Diego county to the U.S./Mexico international border. It is series of sections of land, rather than a single tract, covering 567,000 acres. The Monte Vista Interagency Communications Center (MVICC), is the Emergency Communications Center (ECC) for the Cleveland National Forest. MVICC is a 24-hour all risk communication and coordination center that supports the Fire, Medical Aid, Law Enforcement, and Resource management and protection needs of the U.S. Forest Service, California Department of Forestry and Fire Protection (CDF), U.S. Fish and Wildlife Service, and other cooperating agencies within San Diego, Orange, and Riverside Counties of California. MVICC works with Pacific Southwest Region of the U.S. Forest Service to provide support for large incidents requiring either state or national mobilization of emergency resources.
 - The Federal Fire Department was established in 1982 and is currently the largest fire department in the Department of Defense (DOD). It was formed by consolidating the individual fire departments on each military installation in the San Diego area.
 - Heartland Communications Facility Authority Commission is a Joint Powers Authority between the Cities of El Cajon, La Mesa, Santee and Lemon Grove, and Fire Protection Districts San Miguel, Lakeside, East County, and Alpine.
4. Jurisdiction of the Phase II participating agencies may not coincide with the geographic coverage.
5. A detailed concept of operations has not yet been embraced by Phase II participating agencies, and thus was not provided during the baseline interview process. Therefore, Phase II participating agencies are not yet able to convey how, and to what extent they plan to use InterCAD. These agencies have not had the benefit of previous agency experience to help them develop concept of operations.
6. CHP has made available MediaCAD incident data via the Internet.
7. Law enforcement is not currently represented among the Phase II participating agencies, with the exception of CHP, which has made available MediaCAD incident data via the Internet.
8. CDF and CNF have limited communications with law enforcement agencies that contribute to mutual aid responses. Federal Fire currently uses a ringdown line or conventional telephone service for communication on mutual aid responses, and is in the process of upgrading their communications systems. Heartland Communications also uses a ringdown line, two way radio or conventional telephone service for communication on mutual aid responses, and is in the process of upgrading their communications systems.

5.2 *Operations and Maintenance Procedures and Policies*

Operations and maintenance procedures and policies were not established by participating agencies during the InterCAD project, but future projects will benefit from developing such policies early as part of a Concept of Operations.

No O&M procedures or policies regarding InterCAD have been developed at this time, but the project team recognizes the benefit of developing such procedures and policies early in a project's lifecycle as part of a Concept of Operations (ConOps) document. When developed during the first step of a systems engineering process, a detailed ConOps helps build a common understanding among the project partners as to the purpose and intended use of the product system by identifying and describing the operational scenarios under which the system will be used. A detailed ConOps should clearly describe the functions and responsibilities of each project partner under each scenario.

Other benefits of developing a ConOps either prior to – or as the first step of – an ITS project include:

- ▶ provides reassurance that the project's concept is feasible and worthwhile
- ▶ helps uncover any institutional issues or conflicts early
- ▶ helps identify where institutional agreements such as MOUs might be needed
- ▶ leads to identification of the system's functional requirements

5.3 *Staffing/Skill Levels and Training*

Staffing, skill levels, internal training and associated programs or policies were not established by participating agencies during the course of this evaluation.

During interviews with Phase II agency management and staff, participants indicated that existing staff could monitor the InterCAD Organic solution, whereas the IMX solution, as a stand-alone terminal, would require additional staff.

The system developer provided initial training to users at Caltrans/CHP, CDF/CNF, and Federal Fire as part of the project.

During testing, early users of the system indicated that the graphical user interface button labels and acronyms were "cryptic." Users suggested that training time and retention might be reduced with a more intuitive interface. Simplicity was a desirable quality in the GUI, however, new users found it difficult to translate button labels and command menus into the desired action without assistance or reference materials. Users recommended that future versions of the GUI reconsider the command labels and menus for increased intuitiveness and user friendliness.

5.4 *Competitive Environment*

InterCAD pre-dated other Showcase program activities; therefore, impacts to emerging standards or the single high-level design concept could not be established during the course of this evaluation.

This section discusses findings of Evaluation Objective 3.3. The InterCAD project was ‘grandfathered’ into the Showcase Program. The project pre-dates most of the Showcase high-level scoping and design effort completed in recent years. Additionally, at the time of contract, the project already had a fixed-price design-build contract in place. Therefore, as of the writing of this document, little comment can be offered with respect to the impact of the emerging standards and a single high-level design concept on the competitive environment.

5.5 *Mainstreaming*

Data security concerns limited the participation of law enforcement agencies in the InterCAD Phase II project.

Several reasons contributed to the law enforcement agencies’ data security concerns, and are described below:

- ▶ Uncertainty regarding the security of the InterCAD system and network

Law enforcement representatives conveyed three specific concerns regarding the security of the InterCAD system. First, they were unsure about how securely data was transferred from agency to agency on Pac Bell's Switched Multi-megabit Data Service (SMDS) network (i.e., they were not clear about the message pushing concept). Second, they did not understand how the Showcase Kernel’s Publish-and-Subscribe service would work with InterCAD. Lastly, they perceived the InterCAD system as one that fell outside their concept of strict central control over regional incident data. In short, too much of the network was out of their control or oversight and was potentially vulnerable to “hacking.”

- ▶ Department of Justice (DOJ) requirements and recent audits/inquiries

The DOJ maintains and enforces security requirements regarding the inter-agency exchange of incident data, and performs periodic audits to determine whether law enforcement agencies using their systems and data are operating within those requirements. Law enforcement agency personnel who were interviewed during this evaluation indicated that, based on the outcome of recent DOJ audits, they would be tightening security requirements for access to, control of, and dissemination of, confidential data. Without a complete understanding of any potential security risks that may be associated with the InterCAD project's chosen network service, agency personnel preferred not to participate rather than chance any potential security risks.

Furthermore, since Caltrans is not a law enforcement agency, DOJ policies do not consider it to be a “trusted environment.” This limits how, and to what extent, any incident data can be shared by law enforcement with Caltrans.

▶ Departure of agency management and staff involved in InterCAD Phase I

Over time, some of the management and staff involved in Phase I of the project were transferred, retired, promoted, or became otherwise uninvolved as Phase II of the project began to take shape. This left a gap in common understanding of the project, its goals, and any original agreements between the agencies. Replacement management and staff do not have the benefit of involvement in Phase I and may be facing different priorities within their respective organizations. Some reasons for this include: concern that the InterCAD project and its concept may not be well accepted by agency hierarchy thus reflecting badly on the management that have been asked to support the project.

Based on the above observations, two impacts to the project have been identified. First, the number and type of incidents using the InterCAD system will be reduced. Second, the effects of the InterCAD system on the San Diego area transportation system will be significantly smaller.

The number and type of incidents using the InterCAD system will be significantly reduced while law enforcement agencies are not actively participating. Current active participants in the InterCAD project are primarily federal, county, and city, fire and paramedic departments, and Caltrans. CHP has made available its MediaCAD database via the Internet, although this has not been formally integrated into the InterCAD system design. Therefore, the InterCAD messages are likely to be centered on fire, smoke, hazardous materials, and/or route closures.

Fire, smoke, and hazardous materials related incidents occur much less frequently than traffic incidents. Traffic incidents are the primary cause for unplanned or severely increased traffic congestion. Messaging regarding traffic incidents would usually involve law enforcement. While law enforcement participation is delayed, the use of the InterCAD system, and the resulting data, is likely to be significantly reduced. Thus, any resulting impacts that the InterCAD system may have on the transportation system in the surrounding area will be much less than if traffic incidents were also among the data where the project influenced response efficiency.

The San Diego region has identified that it will benefit from more comprehensive project coordination and system planning, and the development of a regional ITS architecture.

Developments that either hindered or complicated the deployment of InterCAD include the development of ARJIS and the upgrade of agency CAD systems and facilities.

- ▶ Concurrent development of the ARJIS system

An organization of about 37 law enforcement agencies (with Chief level leadership), the Automated Regional Justice Information System (ARJIS), has developed an interagency communications system that provides a data network similar to that of the InterCAD system. The ARJIS is a complex law enforcement computer system that contains information on crime cases, arrests, citations, field interviews, traffic accidents, fraudulent documents, and stolen property. This system, however, is limited to law enforcement and select fire agencies at this time. Law enforcement representatives indicated that participation in the InterCAD project would be potentially redundant with effort already applied to the ARJIS project.

Law enforcement agencies in the San Diego area communicate through common meetings, such as the ARJIS organization. The ARJIS group is a forum for exchange of information between participating law enforcement agencies.

- ▶ Concurrent agency CAD upgrades and facilities expansions

In addition to data security concerns, agencies such as the Sheriffs Department and the California Department of Forestry/Cleveland National Forest were in the process of building and/or moving into new facilities beginning early in Phase II of the InterCAD Project. This activity was cited as a priority for both agencies, thus shifting the focus away from InterCAD participation. Currently, CDF/CNF and the Sheriffs Department's have completed the move into their new facilities.

The Sheriffs Department, San Diego Fire Department, North County Fire Department, Oceanside PD/FD all replaced their CAD systems during Phase II of the InterCAD system development. The aforementioned CAD systems may now require additional modifications to be InterCAD compatible or may require new IMX terminals to provide the InterCAD capability.

The San Diego region recognizes the benefits to be gained by better coordinating its technology projects. Since the Southern California Priority Corridor's formation in 1995, each of the four regions has maintained an ITS Coordinating Team consisting of representatives from Caltrans, CHP, the regional planning organization, local traffic departments, local law enforcement, and transit providers. SANDAG, the San Diego regional planning organization, continues to seek the participation of additional regional stakeholders in order to improve inter-agency coordination and help mitigate complications such as those described above.

San Diego reports that detailed agency-specific Concepts of Operations will aid the integration and mainstreaming of InterCAD and other ITS projects into the processes and procedures of the participating agencies.

The potential benefit of the InterCAD system will not be fully realized if use of the system within current agency processes is not clearly understood by Phase II agency management and users. Although Phase II participating agencies used the InterCAD system briefly during the test phase, its potential benefit as a primary data exchange media may not be realized without the detailed Concept of Operations discussed in Section 5.2. The possibility is that the system may be used only for the dissemination of routine information or as a secondary messaging system.

A Memorandum of Understanding (MOU) was developed for Phase I and sponsored by Service Authority for Freeway Emergencies (SAFE), a countywide joint powers authority between the participating law enforcement agencies. This contains a Concept of Operations for Phase I. A second MOU was developed under SANDAG sponsorship and was proposed to include all of the Phase II agencies. This agreement has been signed by an unknown number of the Phase II participants but closure has not yet been reached.

Task 1.2 of the original federally approved InterCAD work plan was to develop a feasibility analysis, operational concept and operational requirements. A brief project operations concept along with typical operating scenarios was incorporated into subsequent project descriptions and documents. These were high-level operational concepts and were not specific to a particular agency participant. The San Diego region has learned that these high-level operations concepts were not sufficient. Each agency has specific jurisdictional, policy, and procedural requirements that must be accounted for in a significantly more detailed operational concept that thoroughly describes how the system would be used within their specific operations. Development of such a detailed ConOps might have helped identify and resolve the institutional issues earlier in the project.

6 Traveler and Transportation Information Management Evaluation

6.1 Extent of Regional and Interregional Transportation and Traveler Information Integration Between Agencies

The current Phase II InterCAD system is non-operational, but the San Diego region has not abandoned the goal of providing such functionality sometime in the future.

6.2 Utilization of Regional and Interregional Transportation and Traveler Information by Public Agencies

Overall, the introduction of InterCAD as a new means of communicating transportation information was well received by agency management and staff. Prior to the installation of the InterCAD system in participating agency operations centers, various types of regional and interregional transportation information were exchanged by communicating agencies based on need, availability, and each agency's information dissemination policy. As shown in the communications matrices in Exhibits 15 and 16 in Section 5.1, each agency pair used its own communication method (primarily telephone, ring-down line, and CAD systems) to exchange this information.

Conclusions and Recommendations

The vision of InterCAD was to streamline and expedite interagency communications in mutual aid emergency response situations. The intended outcome of this “system of systems” was to dramatically improve regional coordination of multi-jurisdictional incident response through data communications. Incidents that cross jurisdictional boundaries result in coordination problems. Many emergency response agencies use computer systems to manage their resources and to direct field response, and have fielded computers and wireless communications systems to coordinate their own mobile units. However, the various agencies’ systems do not inter-operate, and the agencies have not established a wide area data communications capability. The basic premise of InterCAD was to circumvent any compatibility conflicts by designing a solution that could be integrated into any CAD system through minor modifications of the InterCAD software rather than the participating agency’s CAD system.

The fixed-price InterCAD Phase II contract initially specified an 18-month period of performance; however, delays in Showcase Kernel development, delays by IBM in providing patches to the MQ Server software, changes in participant CAD systems, computer hardware, and facility locations all contributed to a relatively elastic timeline that included periods of inactivity so as to preserve project budget. Thus the overall period of performance was extended several years beyond the originally intended year-and-a-half. The project’s contractor indicates that this overall timeframe does not necessarily reflect the total cumulative time to conduct project tasks. The project contractor also indicated that additional resources and labor were dedicated to the project in excess of the project budget in order to bridge the gaps in activity and make up for unforeseen institutional challenges.

InterCAD was the first Showcase project to reach and successfully complete its testing phase, and did so more than a year prior to completion of the Showcase Kernel and the interregional Showcase Network. As a result, InterCAD could not be integrated with Showcase and additional work will be needed to achieve this.

Data security concerns limited the participation of law enforcement agencies in the InterCAD Phase II project. These concerns are primarily attributed to the potential vulnerability of InterCAD’s leased SMDS network and DOJ policies regarding “trusted computer environments.”

For any interagency system, such as InterCAD, to achieve its vision, to be successfully deployed, and to be fully integrated into the processes and procedures of the participating agencies, the evaluator suggests the implementation of the following recommendations. These recommendations are institutional in nature and are the primary barriers to successful implementation of any technology that involves the exchange of data across real or virtual jurisdictional boundaries:

1. *Be aware of the institutional barriers to participation by law enforcement agencies, and develop a task force or conduct a workshop to address these barriers in future expansions of the InterCAD system or other similar projects.*

The objective of this task force or workshop is:

- ▶ To understand what limitations/barriers exist to keep law enforcement from further participating in Phase II (it is noted that CHP has made available the MediaCAD incident data via the Internet),
- ▶ To determine if there is a method to overcome those limitations/barriers,
- ▶ To decide what needs to be accomplished/changed to overcome identified limitations/barriers and secure further participation,
- ▶ If limitations/barriers are overcome, to determine what then will be the role of law enforcement agencies in this or other Showcase projects,
- ▶ To agree to future actions and a schedule to move forward.

As the organization responsible for transportation planning in the region, SANDAG is the most likely candidate to coordinate and facilitate such a task force or workshop. Participants should include, but not necessarily be limited to, the following agencies:

- ▶ Caltrans
- ▶ California Highway Patrol (local and headquarters staff)
- ▶ San Diego Police Department
- ▶ San Diego Sheriffs Department
- ▶ U.S. Department of Justice

Specific suggestions provided by CHP for participation in such a workshop may include members of the Information Management Division (IMD) such as the Information Security Administrator, Network Management Section, CAD/MDC Unit, technical support officer, or others deemed appropriate by the Division Chief. While this law enforcement issue is specific to InterCAD, the lessons learned may be carried forward to other projects with multiple agency involvement.

Furthermore, since ITS projects often require a change in agency operations policies and procedures, it is imperative to have the involvement of upper management, executive boards, or even legislative bodies.

2. *Develop a mechanism for continued involvement in Corridor-wide activities.*

Standard system interfaces defined by the Showcase Program enable the dissimilar systems throughout the Southern California Priority Corridor to interoperate and exchange information. As technology evolves and systems change, each region must remain in sync with the rest of the Priority Corridor by participating in the standards review process.

3. *InterCAD Phase II participating agencies should develop a task to produce a detailed procedural Concept of Operations.*

Operations and maintenance procedures and policies were not established by participating agencies during the InterCAD project, but the project team identified that future projects will benefit from developing such policies early as part of a Concept of Operations. In order to be meaningful, the operations concept must be developed at a level of detail such that all agency partners fully understand their roles when system operations commence, and the operations concept has full support from the agencies' upper management. Such detailed agency-specific Concepts of Operations will aid the integration and mainstreaming of InterCAD into the processes and procedures of each participating agency.

Endnotes/References

¹ ISTEA requires that “operational tests utilizing federal funds have a written evaluation of the Intelligent Vehicle Highway Systems technologies investigated and the results of the investigation.” Although Showcase is not officially an operational test, it deploys and demonstrates ITS services, functions, and technologies under “real world” conditions, similar to an operational test.

² California Statistical Abstract, Table B-4. California Department of Finance, Sacramento, CA. October 2001.

³ California Statistical Abstract, Table J-4. California Department of Finance, Sacramento, CA. October 2001.

⁴ McCabe, James D., SMDS User Application Trials, March 1994 and October 1997