Long Range Plan for Traffic Management Training
(Discussion Draft)

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May, 2001

Preface

This draft plan was prepared at the request of Robert Copp of the Caltrans Traffic Operations Program. Its purpose is to provide a comprehensive, long range strategy for training the more than 500 Caltrans and Highway Patrol personnel who work in a variety of capacities related to district traffic management centers (TMCs) located throughout California. The plan is presented in these pages and an accompanying web site, where hyperlinks are used to capture the complex linkages among job functions; necessary skills, knowledge, and attitudes; and recommended training.[1]

This plan is based on the knowledge and experience gained through many years of presenting an introductory statewide training program for TMC personnel at Cal Poly. The plan also draws on a number of published accounts of TMC staffing and training requirements which were prepared in recent years. Some limited field survey work was performed to inform the current document; however, much more input from the districts and CHP units is needed to refine the information and recommendations contained herein.

It is hoped that the California traffic management community will adopt this plan as a useful framework-in-progress for improving personnel and institutional capabilities in this important area. The material is presented in considerable detail specifically to encourage review and feedback.

[1] The web site at http://ceenve.calpoly.edu/sullivan/TMC_Training/ contains the detailed structure of the training plan, which is not presented fully in this paper document.

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1. Introduction

1.1 Overview

The Caltrans/CHP *TMC Master Plan* (December, 1997) and the *TMC Standardization Plan*[2] (December, 1998) establish a vision for California's Traffic Management Centers incorporating more standardized systems and procedures. The purpose of standardization is to achieve greater cost-effectiveness, consistent statewide functionality, and economies of scale within an integrated, regionalized organizational and communication structure. Realizing this vision is the responsibility of more than 500 Caltrans and Highway Patrol personnel throughout California. Their work involves operating Traffic Management Centers, Traffic Management Teams, Freeway Service Patrols, and related functions including traffic planning and systems support.

Achieving the statewide vision and meeting local traffic management requirements in an era of rapidly changing technology requires many dedicated, capable, and well informed personnel. This necessitates a comprehensive, long term commitment to developing human resources, and a plan to deliver timely, comprehensive, and effective job-oriented training. This document provides the draft of such a plan.

More than seven years ago, when statewide capabilities of Traffic Management Centers (then "Traffic Operations Centers") were growing rapidly, Caltrans and the California Highway Patrol joined Cal Poly to develop a unique simulation-based training curriculum for traffic management operators. Over the years, this training has contributed to the job effectiveness and understanding of hundreds of agency personnel. Now, at the start of the new millennium, traffic management is entering a dramatic new era, with many new opportunities to effect significant improvements in congestion relief and travel safety, thanks to emerging technologies and the possibility of new institutional alliances for achieving truly multi-modal urban transportation systems. This new era requires a fresh look at what kinds of training, how much training, and what training delivery systems make the most sense in today's traffic management environment, and in the work environment that will evolve during the next several years.

1.2 Purpose of the Long Range Training Plan

This plan is written to provide justification and a roadmap for the delivery of traffic management training to Caltrans and California Highway Patrol personnel in approximately a five-year time frame. It is intended to address the training needs of personnel who work in the following functional areas:

- TMC operators
- CAD operators
- Dispatch personnel
- TMT personnel
- FSP coordinators

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[2] On-line at http://www.dot.ca.gov/hq/traffops/itsproj/tmcsp/plan.html

- District Traffic Managers (lane closure, special event planning)
- Ramp metering and signal coordination personnel
- Public information (media) officers
- Hardware and software infrastructure support
- Field maintenance personnel

The plan also addresses training needs for TMC employees in transition and training needed to adequately prepare new hires for the cited jobs, as well as training for persons seeking job advancement opportunities in traffic management from inside or outside these specialty areas.

The plan addresses the content of needed training, the amount of needed training, and options for training delivery. It makes a cut at estimating needed resources for alternative delivery scenarios and schedules.

1.3 Organization of this Plan

This document has four more chapters and a methodology appendix.

Chapter 2 presents the conceptual approach to establishing training needs, describing a training needs assessment methodology as well as related factors such as the significance to training of measuring TMC performance and possible future expansion of the TMC mission.

Chapter 3 establishes the basis for specifying traffic management training needs. It presents available information about staffing and current TMC functions and tools which influence the recommended training activities.

Chapter 4, which is the heart of the plan, presents an assessment of training needs with a long range perspective. It identifies the types of training thought to be needed both in the near term and over a longer time frame (on the order of 5 years). The chapter addresses the appropriate amounts of needed training in various areas, as well as recommended delivery methods, including the possibility of using emerging computer-assisted interactive tutorials.

Chapter 4 has a companion web page which contains the actual details of the plan. Since the training agenda is complex and conducive to being examined through several different paths of inquiry, it was decided that the web provides the best medium for documenting the details of the material. Presenting the material in an interactive format also was a recommendation of a recent TMC training assessment prepared by the PMR Group for CAATS.[3] Hyperlinks found at the web site permit the reader to explore the plan in a flexible manner, and easily provide opportunities to make comments and suggestions along the way. The web site, which is an integrated and essential extension of this document, is located at: http://ceenve.calpoly.edu/sullivan/TMC_Training/

[3] The PMR Group. *Combating Congestion - Systems and Skills for a High Tech Solution*. Prepared for the California Alliance for Advanced Transportation Systems (CAATS). June, 1999. On-line at http://www.caats.org/reports/ (accessed April, 2001).

Finally, Chapter 5 discusses implementation issues and the levels of resources needed to deliver the training program. Since the levels of resources that might be available in the long term are not known at this time, the need for different resource-related implementation scenarios is discussed.

The appendix, prepared by Larry North, provides a detailed description of the methodology introduced in Chapter 2. This methodology was followed in preparing the details of the current plan, and we believe it should continue to be followed in developing the program further.

2. Approach and Methodology

2.1 Methodology for Assessing Training Needs[4]

Determining training needs is the first step in the development of an effective training program. Needs assessment identifies what employees *need* to learn in order to function efficiently and effectively in the workplace. Typically, training addresses three primary job needs: knowledge, skills and attitudes. A training need should always be linked to the essential knowledge, skills and attitudes an individual must possess in order to be competent. This competency in turn produces desired on-the-job results.

Comprehensive training programs are commonplace in large organizations. Typical methods to evaluate training needs in an effort to develop an effective training program include:

- Survey supervisors to determine essential knowledge and skills necessary for effective job performance
- Survey those who are familiar with job tasks, including experienced personnel and others who may have previously worked in the TMC and related environments. This provides a valuable perspective on performance requirements.
- Review of job descriptions to determine essential skills and knowledge.
- Analyze employee job performance evaluations to determine knowledge, skill, and attitude deficiencies.
- Survey employees themselves and ask them to indicate what knowledge and skills they would need to better perform their job functions.
- Analyze customer feedback, operational reports and other data that addresses job performance.
- Review best practices in other similar operations as an aid in determining knowledge, skill and attitude needs.

Some of these methods were used in developing the current plan, subject to the limited time and resources available to the effort. Clearly, further investigations along these lines are desirable.

Developing a Skills Inventory

Effective job performance is based on a combination of skills, knowledge and attitudes designed to demonstrate competency and produce desired results. Development of a skills inventory is an essential first step to identify training needs. A detailed draft skills inventory organized according to this structure is provided at the accompanying web site.[5] This skills inventory provides direction for selecting and developing training activities linked explicitly to job performance-based objectives.

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[4] This section is drawn from a review of training methodologies for large organizations written by Larry North, which appears in full in the appendix to this report.

[5] http://ceenve.calpoly.edu/sullivan/TMC_Training/

A skills inventory can be determined in much the same way that a needs assessment is. The sources listed above can help determine what essential skills, knowledge, and attitudes should be included in the inventory. Multiple survey techniques exist; however, a clear, concise survey which links the questions asked to desired results is the most useful. Limited surveys of this nature were performed in the development of this plan.

2.2 TMC Performance Measurements

The importance of performance measures to the future TMC role was spurred by the passage of SB 45, which requires consideration of objective performance criteria, and TEA 21, which incorporates performance measures into federal funding programs.

In this regard, Caltrans has recently established nine general transportation system performance measures for statewide use:[6]

- Mobility and Accessibility
- Reliability
- Cost Effectiveness
- Sustainability
- Environmental Quality
- Safety and Security
- Equity
- Customer Satisfaction
- Economic Well Being

Clearly, the majority of these generic measures are amenable to specific application in TMCs and associated traffic management activities. Nationwide, there exist great enthusiasm and anticipation about opportunities presented by new technologies, especially real-time data systems for implementing powerful transportation system performance measures.

TMC benefits can be characterized broadly as system-related and institution-related (external and internal). Specific criteria are needed in both areas. A recent NCHRP synthesis of practice suggests that performance thresholds should play a role in order for TMCs to realize their expected benefits.[7]

Data requirements accompanying the implementation of performance measures are recognized as difficult. Economy requires maximizing the use of existing data sources to the extent possible. New traffic surveillance tools and emerging data fusion techniques,

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[6] UCLA Extension Public Policy Program. *Implementing Performance Measures for Transportation System Users and Investors in California*. Summary of a Conference Held April 22-23, 1999. Sacramento Convention Center. Sacramento, CA. Except where otherwise cited, the majority of statements in this section are paraphrased from this conference summary.

[7] Kraft, Walter H. *Transportation Management Center Functions*. National Cooperative Highway Research Program. Synthesis of Highway Practice 270. National Academy Press. Washington, DC. 1998.

some employing advanced simulation, offer great promise for improvement, however the development and implementation paths are long and difficult.

In adopting specific TMC performance measures, it is important not to force quantification nor obsess about detail. It is important to seek statewide and nationwide consistency when this can be achieved without reducing local effectiveness. Some flexibility is essential so local jurisdictions can develop measures to suit local conditions and needs. The establishment of performance measures should facilitate innovation, not stifle it. On the other hand, staff responsible for implementing TMC performance measures should be aware of data dictionaries and other standards established in the ITS National System Architecture, and endeavor to be consistent with them.

For performance measures to be fully functional, both end users and staff must embrace the overall concept and the regular use of specific indicators. It is recognized that implementation is the most difficult part of instituting effective performance measures in traffic management.

A second recent NCHRP report on performance measures stresses that the process of implementing and using performance measures is far more important than the specific choice of the measures themselves.[8] It was found that performance measures work best when part of flexible guidelines, not when incorporated within strict directives.

Mn/DOT experience cited in this NCHRP study has proven wrong the assumption that once key personnel become involved in designing performance measures and staff become involved collecting the data, the application and use of these measures becomes self-evident. It seems that continuous effort is needed to reaffirm the goals of using performance measures and show staff in each division how to use them.

A recent PATH study by researchers at Claremont College, USC, and consulting firms developed policy principles in support of successful implementation of ITS projects throughout California.[9] Among its many recommendations were:

- Establish a bottoms-up approach to ITS implementation, where local agencies have control and authority, and state authorities disseminate information, serve as facilitators, and provide technical assistance and training to the implementers.
- Significant resources should be devoted to build a deeper understanding of sensing, communications, and information technologies at the local level.
- More uniform reporting of transportation statistics within regions is needed.

The NCHRP Synthesis also states that institutional coordination is among the most important characteristics of TMC organization. Resolving intra-jurisdictional (intra-agency) and inter-jurisdictional (interagency) coordination issues reduces confusion and provides more visibility to the agency's high-level decision makers.

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[8] *Performance Measurement in State Departments of Transportation. National Cooperative Highway Research Program*. Synthesis of Highway Practice 238. National Academy Press. Washington, DC. 1997.

[9] Horan, Thomas A. et al. *California System Architecture Study: Architecture for Action: A Strategy for Facilitating Near-term Deployment*. University of California, Berkeley. PATH Research Report UCB-ITS-PRR-99-3. Available at www.path.berkeley.edu/

The literature on transportation performance measures holds the following significance for Caltrans' long-term training requirements:

- District traffic management personnel should understand how Caltrans' nine general performance measures apply to their particular job functions, and to the functions they supervise.
- District traffic management personnel should be able to participate in the selection of performance measures and/or the collection and processing of related data consistent with their job functions.
- District traffic management personnel need to understand the performance measures adopted by other districts and cooperating agencies, to the degree appropriate to their job functions, and establish cooperative relationships to stay aware of and, where appropriate, influence changes as they occur.
- District traffic management personnel need knowledge of state-of-the-art surveillance, communications, and information processing technologies, and trends in these technologies, to the degree appropriate to their job functions.

Therefore, the theme of integrating meaningful performance measures into TMC operations should permeate the related training agenda. As emerging technologies and institutional changes permit more effective performance measures to be implemented, the training content should adapt accordingly.

2.3 Adapting to Changing Needs

The training agenda which is detailed in upcoming chapters and the companion web site focuses largely on what is needed now, and for the next few years. Although some of the more advanced training modules address state-of-the-art planning tools through which staff can prepare to be leaders in developing the TMC capabilities of the future, specific training to support potential new TMC capabilities is not addressed directly. These include such emerging applications as:

- Integration of TMCs with demand-responsive and event-responsive public transit operations.
- Integration of TMCs with urban parking supply management and real-time parking information.
- Integration of TMCs with demand-responsive road pricing systems, for different modes.
- Use of probe vehicles for surveillance of traffic conditions (possibly based on cellular phone technology).
- Integration of TMCs with congestion-sensitive in-vehicle, kiosk-based, and web-based navigation and trip planning systems.
- Simulation-based data fusion systems for control strategy selection.

With so much that needs to be done to deploy a comprehensive training agenda which fully meets today's requirements, it seems premature to devote much attention to these future possibilities, which are still in the realm of research. However, it should be noted

that the TMC training agenda and the structure within which it is organized are living documents. The intent of the current draft is to provide a comprehensive, transparent, and flexible framework full of specific recommendations, which can be critiqued and then revised to fit the actual needs as perceived by the statewide TMC community. Consequently, the plan is in a form which can readily be modified to incorporate any new training needs which may arise from new procedures and technologies, three to five years, or even farther into the future.

3. Characteristics of the Caltrans/CHP Market for Traffic Management Training

3.1 Quantification of Personnel by Time in TMC

In order to scope the types and required amounts of training, it is necessary to size the market by documenting the number of TMC personnel employed at the various TMCs, and their experience on the job. The following tables summarize such information[10]:

Table 1. Statewide Count of Caltrans Traffic Management Staff by Job Function[11]

Function	Number
Comm./Dispatch	61
DTM - Traffic Plans	47
FSP	4
Hdwr/Sftwr Support	44
Maintenance	15
Ops-Signals/Meters/HOV	64
Special Studies	6
Student	12
TMC Operators	75
TMT	53
Unspecified Supervisor	22
Unknown	3
Total	**406**

Table 2. Breakdown of Personnel by Time in TMC Support

Time on the Job	All Traffic Mgt. Functions	TMC Operators & TMT
<= 6 Months	17%	20%
6 - 12 Months	7%	12%
12 - 18 Months	16%	17%
19 - 24 Months	9%	7%
25 - 36 Months	6%	3%
37 - 48 Months	12%	15%
> 4 Years	33%	27%
	100%	**100%**

[10] These data tables are based on a staff inventory of TMCs and related job functions in all the districts, performed in late spring, early summer 1999.

[11] These counts do not include CHP personnel assigned to TMC-related duties.

These data show that 40% of all district traffic management personnel and 49% of TMC and TMT personnel have less than 1½ years of experience. The Basic TMC Operator's Training Course which has been the mainstay of Cal Poly's simulator-based training was designed specifically to meet the needs of TMC Operators and others working in the TMC who have limited experience. In many cases, the first year or so of TMC employment can be considered an orientation or training period.

We believe that anyone with less then 1½ years of experience working in TMC-related jobs would benefit from taking a set of basic-level training activities which provides introductory exposure to the skills, knowledge, and attitudes required to function effectively within the TMC environment. The training modules which impart these so-called "essential skills" are identified in Chapter 4 and in the companion web site.[12] They include development of effective interpersonal communication skills, partnership and team building, and conflict resolution. In addition, "essential skills" include understanding the mission and organization of TMCs, statewide and local, policies and procedures relating to information dissemination and equipment use, and protocols for communicating with the media and others. Further details about the essential skills training content are presented in Chapter 4 and the companion web site.

We note that just over half of TMC employees, and traffic management personnel generally, have more than 18 months experience, and 40-45% have more than 3 years in this work environment. This identifies a sizable market for advanced training activities, some of a highly specialized nature, as well as for advanced workshops for sharing with statewide colleagues the special problems and solutions encountered in traffic management work, perhaps in the company of outside experts. Chapter 4 and the web site present specific recommendations concerning advanced topics for TMC-related training.

Around 10-15% of personnel fall in the experience category of 1½ to 3 years. Typically, these staff have had the TMC essential skills training. However, some may not yet be at the level to benefit sufficiently from participation in advanced training or advanced workshops. Thus, although their numbers are now fairly small, the importance of fostering career growth in this intermediate group justifies the development of activities geared to their needs for assuming increased responsibility and leadership in their traffic management functions. Although the amount of intermediate training would be limited in the short term, it should increase later as more personnel "age" into these intermediate levels of experience.

Intermediate TMC training could provide comprehensive reviews of skills, knowledge, and attitudes needed to effectively function in the TMC. In addition, sessions could be developed that provide overviews of the skills and knowledge needed for more specialized job classifications.

Employees in certain job classifications, such as Communications and Dispatch

[12] http://ceenve.calpoly.edu/sullivan/TMC_Training/

Operators, and persons classified as Transportation Engineering Technicians, appear to have higher turnover rates than some of the other position classifications. Thus, if it is a goal to decrease turnover and increase retention and job satisfaction, we suggest that specialized activities (or break-out sessions as part of larger training activities) be developed to address the special needs of these key groups.

Obviously, higher job satisfaction leads to decreased turnover. Therefore, if employees have the opportunity to learn new skills that enhance job performance, the amount of turnover within any given classification is likely to decrease. As a result, teams which have been working together for a while are expected to show an overall improvement in the level of job performance.

3.2 Overview of TMC Functions

A recent NCHRP synthesis of practice characterizes the basic TMC role as providing information flow, composed of information gathering, synthesis, and dissemination.[13] The most common TMC functions are incident management, emergency coordination, special event management, interagency information sharing, and surveillance.

Currently, different TMCs within the state have somewhat different inventories of equipment available to perform their work. The amounts and technical details of the equipment also vary. As a result, procedures and protocols differ throughout the state. Tasks performed within each TMC are directly related to the types of hardware and software available. The ability to capture real-time information is an essential determinant in how traffic management centers vary.

Many TMCs have access to the Highway Patrol's Computer Aided Dispatch (CAD) capabilities. This tool allows TMC Operators, working with CHP personnel, to send and receive information about on-going incidents and other events that significantly impact traffic flow. TMC personnel can enter new incident information and can also edit or update existing information. Protocols for using the CAD vary among TMCs, although attempts have been made to standardize abbreviations used in the text descriptions in order to work toward a more consistent format. The implications for consistency are important, since CAD systems are used to transmit messages to other districts. Thus, the need for having standardized messaging formats becomes increasingly important.

Changeable Message Signs (CMS) and Highway Advisory Radio (HAR) are tools used in most TMCs. Both CMS and HAR function as messaging systems to notify the public of traffic problem areas. The larger metropolitan areas, such as Los Angeles, San Diego and the Bay Area, utilize these messaging systems as important communications tools. Most areas also have access to portable CMS for use in areas where permanent signs do not exist.

Other important tools are present in various configurations within the TMCs. These include closed circuit television (CCTV) cameras, direct access lines for the public to call when they notice potential problems on the roadways, media information lines for rapid updates of incident information, emergency call-boxes directly linked to the

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[13] Kraft, Walter H. *Transportation Management Center Functions*. National Cooperative Highway Research Program. Synthesis of Highway Practice 270. National Academy Press. Washington, DC. 1998.

Communications Centers, and loop detectors and other traffic measurement devices for use in incident detection and monitoring.

3.3 TMC Tools in Use by Location

Although the overall goals of each of the TMCs in California are similar, the available resources to achieve these goals vary by location. A detailed inventory of TMC equipment and functions as of late 1998 may be found in the *TMC Standardization Plan*.[14] The fundamental goal of the TMC Master Plan is to provide safe, efficient movement of goods and services throughout the state of California. This goal will be furthered by developing consistent methods for incident management, notification and public awareness, to the extent permitted by local resources.

A significant limitation to the development of a consistent approach to handling roadway congestion is the lack of resources at some TMCs. In this case, we define resources as tools available to assist in job performance. The following table is a general overview of the traffic management tools available in the TMCs. As described in the *TMC Standardization Plan*, the detailed physical characteristics of similar tools also vary.

Table 3. TMC Tools (Hardware/Software) in Current Use by Location

Tools	Tools Available by District							
	3	4	6	7	8	10	11	12
ATMS	X	X(d)	X	X	X		X(d)	X
CAD	X	X	X	X	X		X	X
CMS	X	X	X	X	X	X	X	X
HAR	X	X	X	X	X	X		X
Mainline Loops		X		X	X	X	X	X
CCTV	X	X	X	X	X	X	X	X
Ramp Meter Control	X	X		X	X		X	X
Direct Cell Phone Call-in	X(a)		X(a)	X(b)	X(c)	X(a,c)	X(c)	X(c)
Media/Fax Network	X	X	X	X	X	X	X	X
Emergency Call Boxes	X	X	X	X	X	X	X	X
Portable CMS Systems	X	X	X	X	X	X	X	X

NOTES:
(a) Public phone number for motorists to call TMCs to report delays, etc.
(b) Traffic Reporting Services
(c) Other TMCs call to report delays, etc.
(d) Being installed.

[14] On-line at http://www.dot.ca.gov/hq/traffops/itsproj/tmcsp/plan.html

4. Estimation of Training Needs

4.1 Consequences for Training Due to Differences Among Regions

Since resources vary by location, the inclusion of site-specific training warrants consideration as part of the overall TMC Training Program. Since the overall goal of basic-level training is to provide a general common body of skills, knowledge, and attitudes necessary to function effectively in TMC-related jobs, and since the State's TMCs exist as an integrated system, new employees clearly need more than site-specific training. Furthermore, statewide training on commonly shared topics of value provides some economies of scale.

Although the long-term goal for TMCs is to achieve consistency in procedures, the reality is that this will not entirely occur unless the available tools at all TMCs are largely the same. It is also important to remember that different districts have different patterns and causes for congestion. Thus, by necessity, traffic management techniques and some elements of the related training will vary by district for quite some time to come.

Previous training activities have included the development and delivery of some curriculum materials specific to different TMCs. We believe that inclusion of the local element in TMC training will continue to be beneficial to participating staff members.

4.2 Summary of Training Needs for Different Job Functions

As previously indicated, there are ten general categories of personnel who provide staffing for TMCs and related activities. These include: TMC operators, CAD Operators, Dispatch Personnel, TMT Personnel, FSP Coordinators, District Traffic Managers, Ramp Metering and Signal Coordination Personnel, Public Information (Media) Officers, Hardware/Software Infrastructure Support, and Field Maintenance. Each category has specific duties and responsibilities, as defined in a Duty Statement and as reflected in the detailed lists of job functions found on the companion web site.[15] Training in all these areas of responsibility is important in order to optimize efficiency and improve job performance.

Based on limited in-person and telephone interviews, and other published sources cited previously, we have systematically mapped job duties into the essential knowledge, skills, and attitudes required for proper job performance, for each job category. This information is briefly summarized below, and is presented in greater detail at the companion web site. The web site also makes the distinction between the skills, etc. needed at entry level for each job type (the "apprentice" level) and those needed by experienced "journeyman" practitioners. It should be noted that these descriptions apply to the generic job functions, not official job classifications, and that cross-training across different job classifications is common.

TMC Operators have, among their primary functions, monitoring traffic conditions, including incident assessment and management. Operators are required to interact with a variety of other TMC, office, and field personnel, and some outside organizations, both to receive and convey information, and to disseminate information for the traveling

[15] http://ceenve.calpoly.edu/sullivan/TMC_Training/

public. Effective performance also includes evaluating and documenting the performance of the TMC, and developing plans to improve TMC performance.

In order to effectively perform these job functions, TMC Operators need excellent communication skills, skills for quick and accurate retrieval and dissemination of information from various sources, including several different computer systems, and the ability to function in a high-stress situation and effectively delegate tasks. TMC Operators need a strong understanding of the physical, institutional, and procedural environments in which they function, excellent interpersonal skills, and a solid background in traffic concepts.

CAD Operators, generally CHP employees, are responsible for receiving and responding to information about field conditions via the Highway Patrol's computer-aided dispatch (CAD) system. Their role is primarily keeping on top of what is going on and conveying critical information about important traffic events among office and field units, including Freeway Service Patrol where present.

This job requires some computer terminal skills, strong grounding in related agency procedures, and the ability to relay oral information quickly and accurately in response to situations which develop. In addition, written communication skills are essential, since most communication is via computer.

Dispatch Personnel (including CHP **Communication Operators** in some TMCs) are responsible for dispatching vehicles and personnel to the scene of incidents, and for the radio communications connecting a variety of field units and TMC personnel, as well as CAD Operators.

Dispatch Personnel must be familiar with TMC, TMT and CAD procedures and organization, and basic traffic terminology. Their central role in meeting the goals of improved traffic management, and the corresponding benefits to the traveling public, must be clearly understood and appreciated.

TMT Personnel, who often hold other maintenance and traffic management responsibilities when not responding to incidents, communicate directly with Dispatch Personnel. TMT Personnel provide field response to incidents based on information received from dispatch. Before and after incidents, lead TMT Personnel evaluate and document the outcomes of their actions, and make plans for future deployments.

These functions require TMT Personnel to be well versed in traffic management procedures and field safety, and understand concepts of queue management, lane closure management, and procedures for detours and use of alternate routes. TMT personnel must have good communication skills, especially radio skills, and the ability to process information quickly and accurately, as well as a fundamental understanding of traffic flow concepts. Understanding and appreciating the special TMT role within the overall traffic management mission is essential.

FSP Coordinators have the responsibility of managing contracts with FSP providers. They must report FSP accomplishments, through pertinent data analysis, coordinate traffic management policies with CHP and local authorities, and represent the FSP program to the public.

In order to perform the functions of this job, it is necessary to have a working knowledge of data analysis, through spreadsheets or other statistical analysis software. It is also important to be familiar with Caltrans' traffic management organization, including the DTM function, as well as with CAD, and know how to obtain pertinent information from CAD and other data bases in order to study responses to particular incidents. Strong written and oral communication skills are essential.

District Traffic Managers have the primary responsibility of processing lane closure requests. This function involves reviewing proposed lane closures with regard to potential conflicts with other planned maintenance work and special events, coordinating with multiple agencies to ensure proper public notification, and estimating the traffic consequences of alternative closure plans, including analyses of queuing and meter/signal re-timing required to minimize congestion. The job also entails ensuring permit-holder compliance with conditions of permits, evaluating and documenting the traffic consequences of closures, and representing lane closure activities to the public.

In order to perform this function, it is necessary to have strong knowledge of the principles of field safety, highway capacity, and permit supervision. Also important are basic knowledge of signal timing and metering principles, queuing phenomena, and construction zone and maintenance zone practices; and an understanding of the interrelationships between lane closures and the overall district traffic management mission, including the responsibilities of the TMC. Strong written and oral communication skills are essential.

Ramp Metering and Signal Coordination Personnel assess current and predicted congestion levels on ramps, connectors, and signalized intersections. On this basis, they develop and implement metering and/or signal timing plans for these facilities, and help establish priorities for traffic control improvements. These staff may perform temporary and real-time adjustments to traffic control systems in light of special conditions and events. They develop meter/signal installation or improvement projects and related budgets, coordinate project development with other agency functions, including DTM and TMC staff, with local agencies, and with the public, and oversee contractor compliance.

Personnel working in this capacity must have thorough understanding of signal timing and metering principles and the related analysis tools, principles of highway capacity, field safety, and contracting procedures. Also important are knowledge of queuing phenomena and construction/maintenance zone practices, as well as understanding the relationships between traffic control systems and the overall district traffic management mission, including the responsibilities of the TMC. Strong written and oral communication skills are essential.

Public Information (Media) Officers, usually CHP officers, have the responsibility to keep abreast of traffic conditions, especially as related to incidents, lane closures, and special events, and provide pertinent information to the public through various information dissemination tools. P.I. Officers also help develop and implement policies and procedures for media relationships, and respond to outside inquiries. Understanding TMC activities and interaction with the media and outside agencies is an integral part of performing this job.

Public Information Officers require a solid understanding of the mission and functions of traffic management, especially as related to the TMC, and outstanding communications skills. They should know how to retrieve and interpret information from the CAD, from the ATMS, and other pertinent data systems.

Hardware/Software Infrastructure Support personnel perform a variety of database design and management functions, as well as general computer and communication systems support, preparation of documentation, and assistance to users. Duties involve participation in the development of computer and communication system projects, both long and short-term, including procurement of equipment and software, coordination of system compatibility with other districts, and contract supervision. Troubleshooting, priority-setting, problem-solving, and record-keeping related to system reliability and problem experience are all important job functions.

Infrastructure Support personnel typically specialize in either the software or hardware aspects of these systems. In both cases, they must understand the technical features of the systems with which they work, be able to interpret vendor manuals, understand computer and communication system requirements in the context of the traffic management functions of the TMC and related activities, and be able to provide pertinent and well written technical documentation. They must understand project development and procurement procedures, and remain current regarding evolving technologies and pertinent standards, including the ITS National System Architecture.

Field Maintenance personnel perform scheduled and unscheduled field maintenance and equipment diagnostic activities, and related documentation. They troubleshoot field equipment problems and implement the necessary repairs, either personally or through outside contractors. They coordinate their work with traffic management staff, especially DTM and TMC operators, to minimize traffic disruptions to the extent reasonable.

Field Maintenance personnel must understand the technical features of the systems with which they work, principles of field safety, and the general goals and functions of traffic management within their district. They must know procedures for justification and documentation of field work, and for monitoring contract and permit compliance of contractors. They must have basic written communication skills and good oral communication skills, including skills related to radio communications.

4.3 Summary of Needed Training Content for Different Job Functions

Training for "Essential Skills"

As seen above, each job has specific skills, knowledge and attitudes needed for effective performance. Certain skills are "essential skills," identified as necessary for virtually all TMC job functions. (See modules BAS1, BAS4, BAS5, and BAS7 in Table 4 or the web site.[16]) These include familiarity with local geography; good communication skills; diplomacy and conflict resolution; ability to prioritize, delegate, accept responsibility, and carry out job duties in a potentially high stress situation; basic traffic

[16] Individual training modules are numbered BAS1 to BAS13 and ADV1 to ADV20. "BAS" modules cover comparatively elementary (basic) topics; "ADV" modules cover more advanced topics.

terminology; and knowledge of the overall TMC mission and functions, and how the local TMC relates to the statewide system.

Training in many of these essential skills is incorporated in the statewide TMC training program which for many years has been presented at Cal Poly. We recommend continued refinement and presentation of introductory statewide classes designed to train individuals in these essential skills. These courses should continue to draw on specific situations relevant to TMC operations, so trainees will obtain firsthand experience with TMC operations, while learning essential job skills, knowledge, and attitudes. Case studies and actual incident management situations should be the basis for updated lesson plans and creating hands-on learning activities. Table-top exercises and group discussions should be used as teaching tools to help convey prioritization and delegation skills. Such exercises also facilitate the learning of conflict resolution and diplomacy skills, as well as positive attitudes about colleagues and the work itself.

Although the "essential skills" classes are targeted to new TMC employees and would be pertinent to persons seeking entry into TMC jobs, it may also be of value to some employees to retake the material as a refresher after one or two years of experience.

Training for Job-Specific Skills

Supplementing the training for essential job skills, a draft comprehensive training plan has been developed to cover many additional job-specific skills. The complete plan contains 33 individual training modules, which include the essential skills modules. The modules are listed in Table 4 and, in greater detail, on the accompanying web site.[17] The following summarizes the specific types of training which we feel are appropriate to each job type. The web site also lists options for how each training module can be delivered.

TMC Operators: In addition to the essential skills training (BAS1, BAS4, BAS5, BAS7), we believe each TMC Operator should receive in-depth simulation-based training in the TMC work environment (equipment and procedures) (BAS2, BAS3, BAS6, BAS13), and advanced training in traffic management concepts, including measures of TMC performance and responses to emergency situations (ADV1, ADV3, ADV7). In addition, we recommend training in data entry and analysis using spreadsheets and/or statistical software (BAS8, ADV2) and technical writing (ADV4). Additional advanced training appropriate to senior personnel includes emerging topics in ITS (ASV6) and training in incident detection software (ADV13).

CAD Operators: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), CAD Operators should receive in-depth simulation-based training in the TMC work environment (equipment and procedures) (BAS2, BAS3, BAS13), and training in responding to emergency situations (ADV3).

Dispatch Personnel: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), we believe Dispatch/Communications personnel should receive the in-depth

[17] http://ceenve.calpoly.edu/sullivan/TMC_Training/

simulation-based training in the TMC work environment (equipment and procedures) (BAS2, BAS3, BAS13).

TMT Personnel: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), TMT personnel should receive specific training in the operation and use of radio communications and traveler advisory equipment (HAR, CMS) (BAS6, BAS13), as well as in-depth training in field safety (BAS10).

FSP Coordinators: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), we believe FSP Coordinators should receive advanced training in the measurement of TMC performance (ADV7). In addition, we recommend training in data entry and analysis using spreadsheets and/or statistical software (BAS8, ADV2) and basic writing skills (BAS9). Additional needed training includes budgeting and contract management (ADV8, ADV9).

District Traffic Mangers: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), DTM staff should receive training in field safety (BAS10) and advanced training in traffic management concepts (ADV1), the measurement of TMC performance (ADV7), highway capacity (ADV10), signal timing (ADV11), and related computer tools including selected simulation software (ADV12, ADV14). In addition, we recommend training in data entry and analysis using spreadsheets and/or statistical software (BAS8, ADV2), writing skills (BAS9, ADV4), and public speaking (ADV5).

Ramp Metering and Signal Coordination Personnel: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), Metering and Signal Timing staff should receive training in field safety (BAS10) and advanced training in traffic management concepts (ADV1), the measurement of TMC performance (ADV7), emerging ITS concepts (ADV6), highway capacity (ADV10), signal and metering systems design and timing (ADV11, ADV16, ADV17), and related computer tools including simulation software (ADV12, ADV14, ADV15). In addition, we recommend training in data entry and analysis using spreadsheets and/or statistical software (BAS8, ADV2), writing skills (BAS9, ADV4), and public speaking (ADV5). Additional needed training includes budgeting and contract management (ADV8, ADV9).

Public Information Officers: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), Public Information Officers should receive in-depth simulation-based training in the TMC work environment (equipment and procedures) (BAS2, BAS3). We also recommend training in basic writing skills (BAS9) and public speaking (ADV5).

Hardware/Software Infrastructure Support: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), each Infrastructure Support staff member requires technical training and education appropriate for his/her particular specialty in the computer/communications area (BAS11, BAS12, ADV18, ADV19). Selected staff also require training in advanced transportation application software (ADV13, ADV14), in emerging ITS concepts and system architecture (ADV6), in traffic concepts and measurement of TMC performance (ADV1, ADV7), and in agency procedures regarding data confidentiality (ADV20). In addition, we recommend intermediate training in data entry and analysis with spreadsheets and/or statistical software (ADV2) and writing skills (BAS9, ADV4). Additional needed training includes budgeting and contract management (ADV8, ADV9).

Field Maintenance: In addition to essential skills training (BAS1, BAS4, BAS5, BAS7), Field Maintenance personnel require technical training related to communication equipment and electronics (BAS12), in field safety (BAS10), and in radio communications (equipment and procedures) (BAS13). In addition, we recommend training in basic writing skills (BAS9) and, for senior personnel, in agency procedures for contract management (ADV9).

Table 4. Summary List of Training Modules

#	Training Module Content	Targeted Job Types
BAS1	Communications skills -- active listening and clear expression; conflict resolution; team building	Everyone working in or interacting with the TMC environment
BAS2	Basic TMC work organization; priority setting; task sharing -- delegation and accountability; interaction with field units	TMC Operators; CAD Operators; Dispatchers; Public Info.
BAS3	Orientation to ATMS operation; traffic monitoring; determining system status; basic CAD operation, codes & terminology	TMC Operators; CAD Operators; Dispatchers; Public Info.
BAS4	Orientation to district TMC duties and their relationship to the statewide TMC mission; opportunities for career advancement in traffic management	All TMC and TMC-related personnel
BAS5	Basic traffic and traffic flow terms and concepts	All TMC and TMC-related personnel
BAS6	Operating ATMS, CCTV, CMS, HAR, etc.	TMC Operators; TMT
BAS7	Orientation to local district geography, major traffic generators, landmarks, etc.	All TMC and TMC-related personnel
BAS8	Beginning data entry/analysis using spreadsheets and/or statistical software	TMC Operators; DTM; FSP; Meters & Signals
BAS9	Basic writing for business applications	DTM; FSP; Public Info.; Meters & Signals; Computer/Database Support; System Eng.; Field Maint.
BAS10	Procedures and safety considerations in field work; incident traffic control	TMT; DTM; Meters & Signals; Field Maint.
BAS11	Introduction to Data Processing, Computer Systems and Networks	Computer/Database Support; Systems Engr.
BAS12	Basics of Communication Equipment and Electronics	Systems Engr.; Field Maint.
BAS13	Orientation to radio communication devices; code & terminology	TMC Operators; CAD Operators; Dispatchers; TMT; Field Maint.
ADV1	Advanced traffic management and traffic flow concepts including incident detection algorithms, queuing and ramp metering concepts and analysis	TMC Operators; DTM; Meters & Signals; Computer/Database Support

#	Training Module Content	Targeted Job Types
ADV2	Intermediate data analysis using spreadsheets and/or statistical software	TMC Operators; DTM; FSP; Meters & Signals; Computer/Database Support
ADV3	Orientation to operation and data requirements of state traffic and emergency systems (e.g., CHIN, SEMS); disaster planning and response	TMC Operators; CAD Operators
ADV4	Technical writing	TMC Operators; DTM; Meters & Signals; Systems Engr.; Computer/Database Support
ADV5	Public speaking	DTM; Meters & Signals; Public Info.
ADV6	Orientation to emerging ITS technology; ITS national architecture; exemplary ITS/ATMS case studies from national and international perspectives	TMC Operators; Meters & Signals; Systems Engr.; Computer/Database Support
ADV7	Measurements of System Performance, Efficiency and Effectiveness; Development of Appropriate Performance Measures	TMC Operators; DTM; FSP; Meters & Signals; Computer/Database Support
ADV8	Budget Development and Monitoring	FSP; Meters & Signals; Systems Engr.; Computer/Database Support
ADV9	Introduction to Contract Development; Procurement; Contract Compliance	FSP; Meters & Signals; Computer/Database Support; Systems Engr.; Field Maint.
ADV10	Concepts and Methods of Highway Capacity Analysis	DTM, Meters & Signals
ADV11	Concepts and Methods of Traffic Signal Timing	DTM, Meters & Signals
ADV12	Hands-on Use of Traffic Signal Timing Software (Synchro, etc.)	DTM, Meters & Signals
ADV13	Hands-on Use of Incident Detection Software	TMC Operators; Computer/Database Support
ADV14	Hands-on Use of Emerging Traffic Simulation Software (e.g., CORSIM, PARAMICS)	DTM, Meters & Signals; Computer/Database Support
ADV15	Hands-on Use of Simulation Software for Ramp Metering (e.g., FREQ, CORSIM, PARAMICS)	Meters & Signals
ADV16	Signal System Design; Advanced Signal Timing Analysis	Meters & Signals
ADV17	Ramp Metering System Design	Meters & Signals
ADV18	Advanced Computer Systems and Networking	Computer/Database Support; Systems Engr.
ADV19	Advanced Communication Equipment and Systems	Systems Engr.
ADV20	Caltrans/CHP Policies on Data Confidentiality and Distribution	Systems Engr.

5. Resource Considerations

Effective implementation of a comprehensive training program requires staffing and other resources. Staff dedicated to the development and refinement of curriculum materials will enhance the efficiency and effectiveness of training. Developing a good working relationship with outside agency staff, other training/educational institutions, and consultants lends further support to a well-developed training program, since not all of the required training and necessary training tools can or should be provided from one source. Thus, any discussion of resource considerations is not complete without the inclusion of outside agency and consultant participation.

5.1 Quantification of Training Needs

Specific resource considerations and detailed costs are best determined once detailed curricula have been committed to. However, a preliminary idea of the resources needed can be developed based on the proposed training framework and suitable assumptions about the targeted work force. This information is presented here to encourage comments, after which a final detailed training program can be developed.

Considering known and likely sources of training on particular topics, the 33 training modules identified in Table 4 and on the companion web site can be organized in four categories. It should be stressed that this breakdown is preliminary; further investigation and discussion may result in some modules being reclassified. The four categories are:

A. Training provided on a statewide basis to current TMC and TMC-related personnel, coordinated by Caltrans HQ Traffic Ops. and CHP. (It is conceivable that some or all of these modules could at some point be made available to TMC job-seekers and city, county, and private TMC personnel, pending suitable institutional agreements.)

B. Training provided to TMC and TMC-related personnel at the district level, coordinated by district traffic ops. authorities.

C. Training provided on a statewide basis to a broad range of Caltrans personnel, coordinated by HQ or district training personnel.

D. Training provided by 3rd parties, including ITS Extension classes, adult education providers including community colleges, and regular college degree programs.

Training category "A" can be further subdivided as follows:

A-1. Core TMC training activities, including basic-level topics which are specifically targeted to TMC needs. These activities are identified on the web site as "TMC Statewide Training" modules and have, in the past, been offered in at least rudimentary form as part of the TMC training conducted at Cal Poly.

A-2. Training of a comparatively advanced nature oriented to Caltrans traffic personnel (not just TMC-related) and others, which has been or could be incorporated into ongoing programs, in particular, the Caltrans Traffic Operations Academy and statewide SEMS (emergency management) training. We refer to this as "Generic Traffic Analysis Training."

A-3. Certain advanced training topics, closely aligned with TMC activities, which, as far as we can tell, are not presently available in California, and therefore the development of entirely new training modules appears warranted.

The following subsections address the specific resource implications of these six different categories of training.

A-1. TMC Statewide Training

This training includes basic-level modules BAS1-BAS6, and BAS13, and advanced training modules ADV1, ADV3, and ADV7.

As mentioned previously, certain basic materials called “essential skills training” (BAS1, BAS4, and BAS5) are recommended for virtually all TMC personnel. Some employees already working in their job classifications for a year or two may also need a refresher class in these skills.

If we assume that the time-in-job distribution shown in Table 2 remains stable over time, these data can be used to estimate the annual turnover in TMC personnel.[18] On this basis, about a third of TMC operators and TMT staff (32%) are new to the job each year. This amounts to 41 of the 128 persons in these two job classifications, statewide.

Table 2 also shows that about a quarter (24%) of the people in other TMC-related classifications are new to their jobs each year. However, many of the new supervisors, DTM, and meters & signals personnel (143 total) are already experienced in TMC issues, having advanced to their positions from other traffic management duties.[19] Thus, many people entering these job functions would not need the essential skills training. Assuming that only 1/3 of these personnel have no prior traffic management experience and ignoring student assistants, the number in other job classifications requiring essential skills training each year is estimated as 24% of (1/3x143+205) ≈ 61 persons.[20]

Consequently, based on our assumptions regarding employee turnover and augmenting the totals by 10% for refresher training, the total annual demand for essential skills training (BAS1, BAS4, and BAS5) is 110% of (41+61) = 112 persons.

Similar "bottoms up" analysis was applied to the other training modules. Furthermore, the individual modules were grouped into sessions for logistical convenience. The resulting estimates of training requirements for all modules in category A-1 appear in Table 5.[21]

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[18] This assumption should be checked using personnel data for additional years.

[19] In subsequent calculations, the 25 Caltrans staff listed as Unspecified Supervisors or Unknown in Table 1 were split 50/50 between Meters & Signals and DTM personnel, since those categories receive a variety of advanced training in traffic engineering topics.

[20] Further assumptions were made here to compensate for missing counts of CHP employees in the CAD Operator, Public Information, and FSP Coordinator positions. CAD Operator counts were assumed equal to Dispatch (61), and totals for P. I. Officers and FSP were assumed equal to 16 and 8, respectively, based on the number of districts having those functions.

[21] Like Session 1, demands for Sessions 2 and 3 are based on percentages of 1st year employees. Demands for Sessions 4 and 5 are based, respectively, on the percentages of 2-3rd year (intermediate)

Table 5. Demand Estimates for TMC Statewide Training

Session[1]	Modules	Session Length (days)	Description	Participants	Est'd. Annual Demand	Assumed Class Size	Annual Sessions
1	BAS1, BAS4, BAS5	2	Essential Skills	All TMC & TMC-related personnel	112	20	5 or 6
2	BAS2, BAS3	3	TMC Simulator Training	TMC Operators, CAD Operators, Dispatch, Public Info. Officers	57	15	4
3a/3b[2]	BAS13, BAS6	4 (2/2)	TMC Equipment Orientation	TMC Operators, CAD Operators, Dispatch, Field Maintenance	57	12	5
4	ADV3	2	Emergency Traffic Management	TMC Operators, CAD Operators	20	20	1
5a/5b[3]	ADV1, ADV7	2.5 (2/0.5)	Adv. Traffic Mgt. & Performance Measures	TMC Operators, DTM, Meters & Signals, FSP, Computer/DB Support[22]	35	20	2

Notes: 1. Sessions 1 & 2, as well as 4 & 5 could be scheduled during the same week with selected personnel attending both.
2. BAS6 would follow BAS13 with only TMC Operators (and any cross-trainees) remaining for the second module.
3. ADV7 would follow ADV1 with FSP Coordinators joining to participate in only the second module.

Within this category of training, to entirely meet annual estimated demand requires a total of 17 or 18 sessions (of all five types) and 49-51 total days of training.

A-2. Generic Traffic Analysis Training

This training satisfies some or all the requirements of several of the advanced training modules, including ADV1, ADV3, ADV6, ADV13, ADV15, and ADV17. At this point in time, it is unclear whether the Caltrans Traffic Operations Academy and SEMS training already cover or could cover these topics to fully meet TMC training needs. These questions must be resolved prior to finalizing this training plan.

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and 4th year+ (advanced) employees in the job functions which require those modules. We further assume that 50% of these 2-3rd year and 33% of 4th year+ employees, respectively, receive training each year.

[22] The Hardware/Software Support personnel listed in Table 1 are assumed split 50/50 between hardware and software.

Table 6 summarizes the annual training requirements for the modules in this category.[23] Note that there is some double-counting between Table 6 and Table 5 because of uncertainty about where the material of modules ADV1 and ADV3 will be covered, and between Table 6 and Table 7 because of uncertainty about where the material of modules ADV6 and ADV13 will be covered.

Within this category of training, to entirely meet annual estimated demand requires 6 total sessions (of four types) and 17 total days of training. Note, as stated above, some of this training might replace some of the training identified in categories A-1 and A-3, so the needs in the three sub-categories are not additive.

Table 6. Demand Estimates for Generic Traffic Analysis Training

Session[1]	Modules	Session Length (days)	Description	Participants	Est'd. Annual Demand	Assumed Class Size	Annual Sessions
1a/1b[2]	ADV1, ADV13	4.5 (2.5/2)	Adv. Traffic Mgt. & Incident Detection	TMC Operators, DTM, Meters & Signals, Computer/DB Support	38	20	2
2	ADV3	2[3]	SEMS Training	TMC Operators, CAD Operators	20	20	1
3	ADV6	1	New Tech. and Best Practices	TMC Operators, Meters & Signals, System Engr., Public Info., Computer/DB Support.	31	20	2
4	ADV17, ADV15	4	Ramp Metering Systems	Meters & Signals	20	20	1

Notes: 1. Sessions 3 & 4 could be scheduled during the same week with selected personnel attending both.
2. ADV13 would follow ADV1 with only TMC Operators and Computer/Database Support staff remaining for the second module.
3. It is assumed that TMC staff would participate in two days of SEMS training.

A-3. Newly Developed Training Modules

This training encompasses advanced modules ADV6, ADV7, ADV8, ADV13, and ADV20, which may not be adequately covered by existing training providers, along with

[23] Demands for Sessions 1 and 3 are based on percentages of 4th year+ (advanced) employees, demand for Session 2 is based on the percentages of 2-3rd year (intermediate) employees, and demand for Session 4 is based on the percentages of 1st year employees in the various job functions. We assume that 100% of 1st year, 50% of 2-3rd year, and 33% of 4th year+ employees receive the training each year.

the possibility of creating new tutorial materials to replace some or all classroom work for basic-level modules BAS3, BAS5, and BAS13. These tutorial materials might be administered as correspondence or web-based instruction. At this time, the need for these new training modules is unclear, and will hinge on further investigation of alternative training sources and on additional discussion of its merits.

Table 7 summarizes the annual training requirements for the modules in this category.[24] Note that there is some duplication between Table 7 and Table 6 because of uncertainty about where the material of modules ADV6 and ADV13 will be covered.

Within this category of training, to entirely meet annual estimated demand would require 4 total sessions (three types) and 10.5 total contact-days of training. (Time needed to use the three tutorials is not included.) Note that some of this classroom training would replace some of the training identified in category A-2, so the needs in the different categories are not additive.

Table 7. Demand Estimates for Newly Developed Training Modules

Session[1]	Modules	Session Length (days)	Description	Participants	Est'd. Annual Demand	Assumed Class Size	Annual Sessions
1a/1b[2]	ADV6, ADV13	3 (1/2)	New Tech., Best Practices, & Incident Detection	TMC Operators, Public Info., Support, Meters & Signals, Computer/DB, Systems Engr.	31	20	2
2	ADV20	1	Data Policies	Systems Engr.	3	20	1
3a/3b[3]	ADV9, ADV8	3.5 (2/1.5)	Procurement and Contracting, Budgeting	FSP, Meters & Signals, System Engr., Field Maintenance, Computer/DB Support	23	30	1
4	BAS3 tutorial	n/a	TMC Orientation, Codes & Terminology	TMC Operators, CAD Operators, Dispatch, Public Info. Officers	57	n/a	n/a
5	BAS5 tutorial	n/a	Basic Traffic Terms and Concepts	All TMC & TMC-related personnel	112	n/a	n/a

[24] Demands for Sessions 4, 5, and 6 are based on percentages of 1st year employees, demands for Sessions 2 and 3 are based on the percentages of 2-3rd year (intermediate) employees, and demand for Session 1 is based on the percentages of 4th year+ employees in the various job functions. We assume that 100% of 1st year, 50% of 2-3rd year, and 33% of 4th year+ employees receive the training each year.

Session[1]	Modules	Session Length (days)	Description	Participants	Est'd. Annual Demand	Assumed Class Size	Annual Sessions
6	BAS13 tutorial	n/a	TMC Radio Orientation, Codes and Terms	TMC Operators, CAD Operators, Dispatch, Field Maintenanc	102	n/a	n/a

Notes: 1. Sessions 1 & 2 or sessions 2 and 3 could be scheduled during the same week with selected personnel attending both.
2. ADV13 would follow ADV6 with only TMC Operators and Computer/Database Support staff remaining for the second module.
3. ADV8 would follow ADV9 with Field Maintenance personnel leaving before the second module.

B. District-Level Training

There is some training that clearly is most appropriate to address at the district level. As seen in the detailed list of training modules which appears on the web site (which is an expanded version of Table 4), these include district-specific portions of BAS3, BAS4, BAS6, and BAS13 (orientation to local TMC duties, equipment, and operation), as well as BAS7 (local geography), and BAS10 (field safety procedures).

Due to staffing variability among districts, it is meaningless to provide statewide demand estimates for district-specific training. Consequently, detailed estimates are not provided for this category.

C. Statewide Training in Multi-disciplinary Topics

Table 4 contains a few training modules where it seems that training might be available through general Caltrans training programs which are of value to a broad range of disciplines, including traffic management. Identified as "In-house training," these topics include project budget development, contracting, and policies on confidentiality related to the distribution of agency data. We have assumed that such training is available; however, its content and suitability to traffic management needs have not yet been investigated. Note that these topics also appear under Sessions 2 and 3 of training category A-3 in the event that these modules turn out not to be available from general Caltrans training sources.

Table 8 shows the resource requirements related to these areas of training.[25]

[25] Demands for all sessions are based on the percentages of 2-3rd year (intermediate) employees in the various job functions. We assume that 50% of 2-3rd year employees receive the training each year.

Table 8. Demand Estimates for Multidisciplinary Statewide Training Topics

Session	Modules	Session Length (days)	Description	Participants	Est'd. Annual Demand	Assumed Class Size	Annual Sessions
1	ADV8	?	Budget Development & Monitoring	FSP, Meters & Signals, Computer/DB Support, Systems Engr.	21	30	1
2	ADV9	?	Contracting, Procurement and Compliance	FSP, Meters & Signals, Computer/DB Support, Systems Engr., Field Maint.	23	30	1
3	ADV20	?	Data Confidentiality & Distribution	Systems Engr.	3	30	1

D. Training Provided by 3rd Party Sources

A rather substantial portion of the needed training at both the basic and advanced levels can probably be obtained in a cost-effective manner from outside sources. These include both generic topics such as computer and communication skills, as well as specialized, advanced traffic topics for which training is provided through ITS Extension. Although none of these ITS classes are now specifically geared to TMC issues and the TMC environment, the coverage is directly pertinent to TMC needs.

Table 9 shows the resource requirements for these areas of training.[26] [27]

[26] Demands for Sessions 2, 3, 4, and 7 are based on percentages of 1st year employees, demands for Sessions 1, 5, 6, 8, 9, and 10 are based on the percentages of 2-3rd year (intermediate) employees, and demands for Sessions 11, 12, 13, 14, and 15 are based on the percentages of 4th year+ employees in the various job functions. We assume that 100% of 1st year, 50% of 2-3rd year, and 33% of 4th year+ employees receive the training each year.

[27] To account for the likelihood that a significant number of employees will enter certain jobs already having adequate skills in certain needed areas, tabulated demands were reduced by 50% for Sessions 2, 3, and 4 and 25% for Sessions 5 and 6.

Table 9. Training Expected to be Provided by 3rd Party Sources

Session	Modules	Session Length (days)[1]	Description	Participants	Est'd. Annual Demand	Assumed Class Size[3]	Annual Sessions
1	BAS8	4[2]	Beginning data entry and spreadsheet analysis	TMC Operators, DTM, FSP	21	20	1
2	BAS9	4[2]	Writing for business applications	DTM; FSP; Public Info.; Computer/Data base Support; System Eng.; Field Maint.	17	40	<1
3	BAS11	4[2]	Intro. to data processing & networks	Computer/Data base Support; Systems Engr.	5	40	<1
4	BAS12	?[4]	Basics of Communications and Electronics	Systems Engr.; Field Maint.	4	40	<1
5	ADV2	4[2]	Intermediate Data Analysis	TMC Operators; DTM; FSP; Computer/Data base Support	18	20	1
6	ADV4	4[2]	Technical Writing	TMC Operators; DTM; Computer/Data base Support; Systems Engr.	20	40	1
7	ADV5	4[2]	Public Speaking	DTM; Meters & Signals; Public Info.	38	20	2
8	ADV10	3	Highway Capacity Analysis	DTM, Meters & Signals	22	30	1
9	ADV11	2	Basic Signal Timing Concepts & Methods	DTM, Meters & Signals	22	30	1
10	ADV12	2	Signal Timing Software Apps.	DTM, Meters & Signals	22	20	1
11	ADV14	2	Traffic Simulation Software Apps.	DTM, Meters & Signals; Computer/Data base Support	24	20	1

Session	Modules	Session Length (days)[1]	Description	Participants	Est'd. Annual Demand	Assumed Class Size[3]	Annual Sessions
12	ADV15[5]	2	Ramp Metering Software Apps.	Meters & Signals	12	20	1
13	ADV16	3	Signal System Design; Advanced Signalization	Meters & Signals	12	30	1
14	ADV18	3[2]	Adv. Computer Systems & Networking	Computer/Data base Support; Systems Engr.	7	30	<1
15	ADV19	2[2]	Advanced Communication Equipment & Systems	Systems Engr.	3	30	<1

Notes:
1. Session lengths are based on actual classes or estimates based on experience with similar classes.
2. Classes available through adult ed. providers may involve 2-3 hours per week spread over a 10-15 week period.
3. Class sizes and sessions are relevant only in cases where classes might be mostly or entirely composed of Caltrans TMC personnel.
4. BAS12 is visualized as an AA or BS degree program, depending on level of the employee's responsibility.
5. An updated class on ramp metering software applications would probably need to be developed.

5.2 Facility Considerations

While much of the training envisioned in this plan can be done almost anywhere, several key training modules require specialized facilities. In particular, key components of the TMC Statewide Training (modules BAS2, BAS3, BAS6, and BAS13) should occur in a simulated work environment, where trainees can receive hands-on training on actual TMC equipment and participate in simulated work activities designed to give experience in realistic inter-personal interactions and to create rare traffic management events which are important to prepare for. In addition, some advanced modules which provide hands-on software training require access to suitable computer labs.

For many years, the statewide training which requires a simulated TMC environment has been conducted at the Cal Poly TMC Simulator Facility. Although features have been upgraded from time to time, the Cal Poly facility has not been able to keep pace with technological developments which have been occurring at the actual major district TMCs. While it still provides the only facility of its kind in California, and remains useful for providing training in basic procedures, inter-personal interactions, and preparing for contingencies, it cannot currently provide hands-on training on the actual equipment and software found in many actual TMCs.

In the meantime, Caltrans has invested in constructing a new training facility co-located

and linked with the District 12 ATMS Testbed which was developed at the U.C. Irvine Institute of Transportation Studies. When fully developed, the UCI training facility is expected to provide a setting where trainees can receive hands-on exposure to state-of-the-art equipment and software. It is presumed that the UCI facility will also provide the capability to simulate the actual TMC work environment with its state-of-the-art systems.

At this time, the specifics of how the Cal Poly and UCI training facilities will be used in support of TMC training over the next 2-5 years are not entirely clear. Certainly, the availability of the UCI facility, once it becomes available, could significantly enhance training modules BAS3, BAS6, and BAS13, which focus on hands-on systems training, especially for districts whose TMCs have the state-of-the art systems. The UCI facility may also provide a suitable location for some advanced training modules, which demonstrate or provide hands-on training in specialized simulation software, such as modules ADV13 through ADV15.

The Cal Poly simulator facility will remain functional for many years as a site for training which emphasizes work allocation and interpersonal interactions in the work environment (BAS2) as well as hands-on training (BAS3, BAS6, BAS13) for personnel of TMCs where state-of-the-art systems are not yet deployed. Depending on how the training evolves, there may also exist opportunities to upgrade equipment and software in order to expand the functionality of the Cal Poly Simulator for selected applications.

It is anticipated that a number of the advanced training needs in traffic modeling and computer applications will be met through existing classes offered by ITS Extension. These include ADV10 through ADV12, ADV14, part of ADV16, and possibly ADV13 and ADV15. The hands-on computer training in this group can be presented in standard computer labs, which are widely available.

5.3 Recommendations for Action in FY 2001/2002

Although many job-specific training modules are already available from various providers (see details regarding training providers at the companion web site[28]), implementing some of these recommendations will require new curriculum materials and a significant investment of resources over a period of several years.

The need is obvious for continuing essential skills training and hands-on simulator training, as well as for supporting the enrollment of selected personnel in a variety of available job-specific training modules. Additional curriculum development beyond the currently available offerings should be approached cautiously. During the next fiscal year, senior Caltrans and CHP traffic management staff from the districts and HQ should make a systematic effort to critique and refine the current plan, as the foundation of an ambitious agenda of training and training development in the years to come.

Based on the estimates in Table 5, it appears that demand justifies up to six offerings of the statewide TMC training in fiscal year 2000/2001, utilizing facilities already in place and following essentially the previously established curriculum, modified to facilitate some personnel attending only the 2½ day essential program which is targeted to

[28] http://ceenve.calpoly.edu/sullivan/TMC_Training/

everyone, while new TMC Operators, CAD, Dispatch, and Public Information Officers remain a full 5 days for hands-on simulator training. In addition, at least one “Advanced TMC Workshop” should occur, where current topics of concern to TMCs would be addressed along with the work to refine this Training Plan. The Advanced Workshop would be geared toward senior staff with four or more years of TMC experience.

As noted, the next year should be used to solicit comments and further refine this Training Plan. As consensus emerges, and in conjunction with other interested organizations, plans for creating more curriculum materials and comprehensive lesson plans should be implemented, following the methodology described in the appendix to this report. These curriculum materials will serve as the basis for new training sessions to be developed and offered in subsequent years.

5.4 Alternative Implementation Scenarios/Schedules

The key recommendations of this Plan, especially the quantification of needed training, are based on a 1999 survey of Caltrans TMC personnel, which is summarized in Table 1 and Table 2. Many assumptions needed to be made to apply these data to estimate training needs. While we believe these assumptions are reasonable, some are rather arbitrary. Therefore, this long range training plan could be placed on a more solid foundation if a follow-up personnel survey were conducted to update and extend the 1999 data set. While an updated snapshot of TMC personnel would not change the content of the recommended training program, the amount of training needed on various topics might change.

This Plan is based on limited input from experienced TMC personnel from throughout California. It has been developed as a framework in the hope that the California TMC community will buy into its basic approach and, through comments and suggestions, help it evolve into a consensus long-range plan. As noted previously, the accompanying web site is designed to facilitate such an evolution.

If the underlying assumptions are correct, the resource estimates detailed in Section 5.1 should be seen as the outer envelope for implementing comprehensive training. Many variations within this envelope are possible, including only partly meeting the estimated training needs for some or all job functions in a given year. For some training modules, Section 5.1 also defines alternative methods for delivering the same training; therefore, choices need to be made about what combinations of training methods to develop and employ.

For this document, we decided it was premature to try to oversimplify the presentation of available training options, for example, through the definition of high, medium, and low resource consumption scenarios. Eventually, doing so will be a useful exercise, but at this point in time it seems more appropriate to focus on the full envelope of possibilities in order to elicit comments on the structure and content of what is proposed. Once the overall vision is refined, and a consensus established, the resulting program can be fit to alternative funding levels.

5.5 Cost-Sharing Opportunities (Local, Federal, State)

We recommend that a Memorandum of Understanding (MOU) be developed between Caltrans and the CHP. This MOU would indicate the roles and responsibilities of each

involved agencies regarding TMC training. It would also deal with the financial responsibilities involved. Clearly defined roles and responsibilities will greatly improve the development and delivery of training materials.

Complementary to the detailed curriculum development and consensus-building proposed for the upcoming year, an effort should be made to solicit input and cooperation from FHWA, California cities with TMC programs, and possibly other state traffic management authorities. Opportunities for cross-training with cooperating agencies and cost-sharing of curriculum development need to be more fully explored.

Appendix -- Methodology Review (Larry North)

Transportation Management Center

A Brief Review of Training Methodologies Used in Established Training Programs for Large Organizations

March 7, 2000

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1a. Assessment

Determining needs is the first step in assessment and in planning and delivering an effective training programs. Needs assessment deals with determining what *needs* to be learned. Training typically can address three primary job needs: knowledge, skills and attitude.

In order to assess this, one should think of a need as a performance gap which separates what people know, do, or feel from what they should know, do, or feel. A need should always be linked to the essential knowledge, skills, and attitudes an individual must possess to be competent and therefore accomplish the desired results.

Here is a list of common ways that large organizations determine workplace training needs that are appropriate for TMC:

1. Ask the supervisors of the participants.
2. Ask others who are familiar with the job, including experienced operators and peers.
3. Examine the job description.
4. Ask the participants.
5. Test the participants.
6. Analyze customer feedback, operational reports and other data available on performance.
7. Analyze performance appraisal forms.
8. Benchmark best practices in similar operations (e.g., transportation, law enforcement, or the military).
9. Establish an advisory committee.

Another excellent source, expanding on #2 above, is to survey those who have rotated out of TMC positions since TMC now has many veterans statewide. They would provide a unique perspective on the performance requirements.

Refer to Robert Mager, *Making Instruction Work,* and Dana and James Robinson, *Training for Impact,* for detailed discussions on assessing instructional needs.

1b. Skills Inventory

Determining skills for operators is related in many ways to assessing needs. One can ask: *What are the essential (or core) skills an operator needs to perform his/her job competently, and what are some additional desirable skills we would like to see*? Borrowing from the previous list, here are some good ways to determine what skills are "in the inventory":

1. Ask the supervisors of the participants.
2. Ask others who are familiar with the job, including experienced operators, peers and former operators.
3. Examine the job description.
4. Talk with customers (both external and internal) about what specifically has satisfied them in successful interactions with TMC operators.

5. Benchmark best practices in similar operations (e.g., transportation, law enforcement, or the military).
6. Consult with an advisory committee.

Here is one experienced person's answer to question, *"What are the essential (or core) skills an operator needs…*" posed above:

Skills which enhance the performance of TMC operators.

- Verbal Communications (Clear English)
- Typing
- Ability to work under pressure
- Ability to work while being watched
- Handle Multiple Tasks
- Two Way Radio Operation
- Transportation System Knowledge
- Computer Knowledge

Other Desirable Qualities:

- Calm Demeanor
- Courteous and Helpful
- Good With People
- Self Confident
- Pride in Work
- Positive Outlook
- Traffic Engineering Experience
- Good Golfer

These are just a few skills/qualities that come to mind. – PK

Many of the items in this list are really "abilities" which are made up of component skills. A functional skills inventory must focus on the discreet skills which cluster to create abilities.

Mager makes a useful distinction when he talks about the concept of a Skills Hierarchy as it relates to the objectives of instruction. A Skills Hierarchy is a chart or picture which shows the prerequisite relationships between skills.

When training is not grounded in a solid assessment of performance needs and attendant skills and translated into meaningful learning activities, the result is what veteran trainers often call "chalk and talk" or "spray and pray" instruction. Via these methods, learning occurs only by accident.

Jonathan Schiff, a professor of accounting at Fairleigh Dickenson University and executive director of the Finance Development Training Institute in Montvale, New Jersey, puts it this way:

> "It's not good enough to simply throw general training at the problem. Companies toss away millions of dollars and don't get any real return on investment. Without linking your training and development to some kind of improvement within the department and company, you're just spinning your wheels." (*Workforce*, February 1999, Vol. 78, No. 2, pp. 95-96.)

Currently, more tools exist than ever before to:

- track competencies and skills
- identify gaps in employee knowledge and skills, and
- create the necessary training courses to address specific needs.

Combine a skills database with an appropriate learning technology and you have the basis for powerful instruction.

Several major Human Resource Management System (HRMS) and distance learning vendors now offer features that help managers understand the skill level for departments, groups of employees and individuals. By tracking such information, managers are able to better prepare their employees for organizational needs and challenges. See the **Summary & Recommendations** section for a recommendation.

2. Design Training Materials

Trainers, supported by a solid needs assessment, must be able to clearly define what the performance tasks are, help participants envision what a "good" performance looks like, and see the linkage between the tasks and the goals of their work unit and/or organization.

While the use of learning technologies brings new factors into the delivery equation, good instruction—which is about satisfying the learning goals—is good instruction. So whether the design is traditional, technological, or both, the "lesson" is typically designed with the following general requirements in mind:

a. Instructional Goals

Instruction is targeted at the need "gap" between a desired outcome or performance (a goal) and the present performance. Having determined the needs of the learners in Step 1, instructional goals can be established.

This step consists of identifying the instructional goal(s), or what the learner should know and/or be able to do when they have completed the learning process. A goal may be defined as a desirable outcome or performance. Generally, the most effective general design of traditional, classroom training for adults in the workplace is an approach which can be labeled Instructor-led and Learner-centered.

b. Learner Characteristics

An important part of contemporary instructional design is to determine which of the required knowledge and skills learners bring with them to the learning process or task. Some learners will know more than others, so it is extremely important for the instructional designer to determine where to start the instruction. The designer must also determine for which learners the instruction may not be appropriate.

c. Performance Objectives

Performance objectives state how the goal(s) are to be accomplished. Performance objectives contain *specific* knowledge, skills, and attitudes the learners should gain and be able to demonstrate. Performance objectives are to be listed in terms of what the learner will know and be able to do as a result of the learning process or lesson.

d. Instructional Strategy

Instructional systems should contain an instructional strategy which specifies a plan for assisting

the learners with their efforts for each performance objective. This often takes the form of a lesson plan or a learning framework. The purpose is to outline how instructional activities will relate to and assist the learner with meeting the performance objectives. Appropriateness, variety and efectiveness of instruction are three key factors.

e. Develop Materials

The instructional materials and media used for the target audience is critical to learning. Instructional design should place a high level of importance on the selection and development of learning materials.

The more well developed the performance objectives, the more appropriately instructors can determine or develop the required learning materials.

f. Formative Assessment

Formative evaluation provides data for revising and improving instructional materials on an ongoing basis. The purpose of revision should is, of course, to insure that the instructional materials are as effective as possible for the largest number of learners.

g. Summative Assessment

Assessment of the effectiveness of an instructional system *as a whole* is summative evaluation. A summative evaluation is conducted after the learning course (or system) has passed through the formative stage (i.e., when it is no longer going through stage or development revision).

h. Continuous Improvement

Continuous improvement or course maintenance is necessary to insure that the learning materials remain effective and efficient for future learning groups. This should be thought of as a continuous feedback loop to continuously maintain and improve the quality of the learning process.

As this brief report moves towards its central section—delivery of instruction in an age of new and powerful media—one crucial fact is supported again and again when examining the experience of large and leading-edge organizations: *no amount of technological bells and whistles can make up for poorly designed instruction.*

The best delivery system for any given organization is one which maximizes learning and return on investment. And that delivery system may well vary for learners with different needs, learning different things, at different times, at different sites.

3. <u>Delivery of Instruction</u>

So, with a rapid review of instructional assessment and design as a foundation, here are the key questions?

- What types of learning technologies are large organizations using?
- How effective are they? How do they compare with the traditional Instructor-led and Learner-centered approach?
- With our finest crystal ball, how will the next five years likely unfold in large organization training and development departments?

- And, what recommendations can be made to inform TMC's Long-Range
- Training Plan?

Delivery of Instruction is now one of the most critical choices facing any organization. More than ever, technology affords options not available when TMC began. Many corporations have discovered that Web-based or other technology-based delivery can be faster and cheaper than traditional classroom training. Effectiveness, however, is still a real question.

In researching this brief report, *I could find no recognized studies which demonstrate definitively that technological delivery systems are categorically more effective than traditional instruction.*

But there certainly are strong experiences and beliefs about Web-based or technology-based training.

Training magazine published an excellent and informative article called "10 Things We Know So Far About Online Training" (11/99).

Among its most significant findings were: One, when taking an online course, the learner—not the trainer—is in control. Two, while online courses are judged effective for teaching structured, especially technical material, they usually fall short when it comes to helping participants translate those lessons to the real world. Three, students will *not* take courses on "their own time". They will do them during normal work hours. Four, at Sun Microsystems, training managers observed that 45 minutes was about the most time people would work on an online lesson. Five, again at Sun Microsystems, when employees were told to complete a self-paced online course without the help of a tutor, only 25% finished. When given the same assignment and access to a tutor, 75% completed the training. Finally, even IBM, which estimates that the company saves $500,000 for every 1,000 hours of training held outside the traditional classroom, does not envision abandoning the classroom. Rather IBM and a number of other organizations are using a combination of online and classroom instruction.

Experts at both Sun and IBM—two leading-edge technology companies—predict that Web-based or online courses will account for 50% or more of all training by 2002. But they suggest the single biggest unknown "is how willing, able and interested the user is to use these new technologies for training…At this point, no one knows the answer."

For the purposes of this report, I will define Web-based or other technology-based **learning technologies** as the use of one or more of the following electronic technologies to deliver information, develop or improve skills, or change attitudes:

- Intranet
- World Wide Web (Internet)
- CD-ROM
- Videoconferencing

Companies that engage in more competency-based training, high performance work practices, and innovative training practices are more likely to use learning technologies. Such results support the idea that innovative companies are moving towards learning technologies and away from classroom instruction.

A look at the types of presentation and delivery methods that companies are using brings us back to reality. Overall, companies continue to rely most heavily on conventional instruction methods.

More than 90 percent of all respondents to the American Society for Training & Development (ASTD) Human Performance Practices Survey (HPPS) reported using videotapes and workbooks; less than 10 percent said that they are using new interactive, digital technologies-such as videodiscs, intranets, the Internet, and EPSS (Electronic Performance Support Systems).

In fact, more than 35 percent of the organizations as a whole are using no learning technologies at all. But the use of learning technologies is more prevalent in leading-edge firms, in which such presentation methods as text-based CBT (Computer-Based Training) and distribution methods such as CD-ROM (which have been around for years) have made significant inroads.

Taken as a whole, HPPS data on the expected change in learning-technology-delivered training from 1996 to 2000 suggested that most companies expected their use of learning technologies to grow. Half or more projected increases in their use of CD-ROM in particular and in text-based CBT, multimedia, intranets, the Internet, and videoconferencing.

I urge you to read The 1998 ASTD State of the Industry Report in full online at www.astd.org.

The 1998 Human Performance Practice Survey (HPPS)
Comparing Use of Delivery Methods

	Entire Sample	Leading Edge	Benchmarking Forum
Instructor-Lead Courses as % of Training Time	84%	81%	70%
% of Organizations Using			
CBT	35%	66%	84%
CD-ROM	30%	44%	N/A
Multimedia	22%	31%	81%
EPSS	7%	16%	37%
Intranet	3%	13%	N/A
% of Growth in Training Time by 2000			
CD-ROM	20%	23%	N/A
Intranet	17%	22%	N/A

Internet delivery has exploded in the last two years. There is remarkable consensus that the World Wide Web will soon become the dominant vehicle for online, Web-based course delivery. It is relatively cheap, easy to update and ubiquitous. And when the Return on Investment (ROI) factor is considered, the relative cost efficiency of the Web becomes even more prominent.

Still there are technical issues. Studies of Internet users show people are willing to wait about two seconds for a page to download before they get frustrated. With instructional designers trying to include large graphics, photos, animation and video in their courses, too little bandwith causes gridlock. Today, with most Web-based training, restrictions imposed by organizational as well as technological constraints often have put severe limits on the use of more interactive multimedia and also on the designer's options for offering interactive feedback to the learner.

The good news—according to an overwhelming majority of experts—is the expectation that the lack of high-speed Internet access or broadband will be solved within three years, and as Kevin Kruse, author and consultant says, "…broadband will become as common as today's 56K modem."

The implications for TMC training over the next five years are clearly significant.

What investment will be made (and where?) to provide the technology infrastructure to create broadband for the Centers themselves? What general level of technology is anticipated in the partner agencies of Caltrans and CHP? And at what level and for what training and development purposes would Internet (or Intranet) delivery be used?

Clearly, though, any long-range planning in the year 2000 for large and geographically diverse organizations *must* take into account the current reality and the staggering potential of Web-based training.

See the **Summary & Recommendations** section for a list of planning considerations

4. Performance Evaluation

We choose to evaluate our training courses and programs to determine their appropriateness and effectiveness.

The classic resource in HRD evaluation is Donald L. Kirkpatrick, *Evaluating Training Programs: The Four Levels.* This is a must read for anyone designing, delivering or managing training efforts.

Kirkpatrick developed The Four Levels nearly fifty years ago. They cover the range of evaluation from the individual learner to the payoff for the organization.

The Four Levels are:

Level 1 — Reaction
Level 2 — Learning
Level 3 — Behavior
Level 4 — Results

As the evaluator moves from one level to the next, the process becomes more difficult and time-consuming, but it also provides more valuable information.

Level 1 — Reaction — is the measurement of customer satisfaction gathered from the course participants. We almost always do Level 1 and should. It is easy to perform and we, as training instructors, need and want a positive reaction from our learners for two main reasons. One, the future of the course (and perhaps our job) depends on a positive reaction. Two, while positive reaction does not ensure learning, negative reaction almost certainly reduces the chances of effective learning.

Level 2 — Learning — is defined as the extent to which participants improve knowledge, increase skills, and/or change attitudes. Learning is harder to measure formally than reaction, but it is a more valuable measure. Typically this is done by means of a pre/post test targeting core learning objectives. Having good data on the improvement in knowledge, skills, or attitudes is clearly a better way to judge the effectiveness of instruction and to guide course improvements.

One specific pre/post test resource is provided in the **Summary & Recommendations** section.

Level 3 — Behavior — can be defined as the extent to which change in behavior has occurred because the learner attended the training program. Evaluating behavior is more difficult still for several reasons: one, even though reaction is favorable and the learning objectives are accomplished, behavior may not change. Kirkpatrick says that for change to occur, four conditions are necessary:

1. The person must have a desire to change.
2. The person must know what to do and how to do it.
3. The person must know work in the right climate.
4. The person must know be rewarded for changing.

Both #3 and #4 above relate to the "on the job" environment and the critical influence of the learner's immediate supervisor. Despite excellent instruction, no change in behavior is probable if the "on the job" environment prevents or discourages the new behaviors.

Level 4 — Results — can be defined as the final outcomes that occurred because the learners attended the training. Ideally, they are tangible matters like increased production, improved quality, fewer mistakes, and reduced turnover. All skill improvement trainings have improved results as an objective. Other types of learning, courses on diversity, communication or leadership, for example, may take a long time to bear results and may not be easy to quantify. But is always intended that improved results will follow.

While results are the most difficult to measure, they are the most powerful indication of the worth of training. Kirkpatrick encourages evaluators to consider developing or adapting some form of ROI—cost versus benefits—formula. And, he counsels evaluators to be satisfied with reasonable evidence of results because "proof is usually impossible to get."

Adopting this model for program evaluation and progressing "up the levels" cannot help but improve the courses themselves and the image of the training program. Using Four Level evaluation is a proven way to satisfy learners, their supervisors, and the senior decision makers who must support the very existence of the training function itself.

5. Summary & Recommendations

Recommendations

As an external training consultant who has worked with TMC operators for nearly five years, I am an outsider who knows you rather well. Within that framework and with the learning of preceding report in mind, here are a handful of suggestions and/or recommendations:

1. Use of any kind of learning technology would be indicated for periodic training updates, refresher courses, those new to TMC, and those who cannot attend a full-featured, week-long training in San Luis.
2. All the evidence suggests that, despite everything technology can do, people still need to collaborate, especially to promote transfer of training with the "soft skills." I am reminded of *Megatrends*, written by John Nesbitt twenty years ago. Predicting the enormous influence of technology with accuracy, he maintained fully that "High tech, high touch" was essential to satisfy the human needs of people in an age of ever-

increasing technological impact. Most students still need (and want) teachers and other students to make them feel comfortable and help facilitate their learning.

3. Conversely, although classrooms will always remain essential for certain types of instruction, and computer-based training (CBT) continues to ripple through the corporate landscape, the future clearly lies in Web-based training (WBT). It allows interaction in ways that nobody could have predicted just a few short years ago. Using a PC, modem or network, and a Web browser, it's possible to log on and learn without regard to geography. As stated before, TMC's long-range planning *must* account for the promise and potential of Web-based training.
4. While waiting for the arrival of supersnort computers and broadband, consider getting started by designing courses with the technology you have. You need to learn too, and appropriate uses (i.e. #1 above) would allow you to experiment with the use of learning technology. Consider partnering with the right consulting group if resources are not available within.
5. Consider expanding your Level of training evaluation. As a companion resource for Level 4, ASTD has an ROI link on its web site at www.astd.org. Given the political reality of your funding and the many "publics" you serve, any work done to demonstrate the results of training to a positive or improving bottom line would be very valuable.

Recommended Resources

Training Register

A complete corporate training management system. Track and schedule training; set requirements; monitor needs; track license requirements; track and rate employee skills.

Contact: Training Register
www.chriscollins.com
316-942-4339

DBM

Drake Beam Morin, a Harcourt Professional and Corporate Development company.

A state-of-the-art multiple-media learning company that provides publishing, training, assessment and administration products and services. They have produced and market the DBM Knowledge Communication Library, a stunning, Web-based curricula.

Contact: DBM
www.knowledgecom.com
800-851-4134

Level 1 and Level 2 Evaluation

San Jose State University has a very useful and affordable Reaction (1) and Learning (2) Evaluation. It has a 20-question true/false pre-test, along with a Likert scale for each question measuring the "Confidence Level" that the participant has in choosing the answer (1=Certain of answer to 5=Just guessing). Fully 90% of organizations (e.g. PG&E) contracting for training choose to use this instrument.

For the Project Management class Evaluation package I obtained, and with 16 students enrolled, the scores rose from 75% correct on the pre-test to 90% on the post-test. More strikingly, the pre-

training Confidence Level of 33% rose to 81% on the post-test.

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Society for Human Resource Management (SHRM): www.shrm.org

TCM: www.tcm.com

The Learnativity Alliance: www.learnativity.com

Training Supersite: www.trainingsupersite.com

Magazines

Inside Technical Training magazine: www.ittrain.com

Training magazine: www.trainingmag.com

Workforce magazine*:* www.workforceonline.com