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**TravInfo Evaluation (Technology Element)
Traveler Information Center (TIC) Study:
*Operator Interface Component-Phase IV:
Institutional Analysis***

**Mark A. Miller
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ABSTRACT

TravInfo is a Field Operational Test of advanced traveler information systems for the San Francisco Bay Area, sponsored by the Federal Highway Administration (FHWA). The project involves a public/private partnership which seeks to compile, integrate and broadly disseminate timely and accurate multi-modal traveler information through commercial products and services. The public sector component centers on the Traveler Information Center (TIC), which collects and integrates both static and dynamic traveler information. The TIC began operations in September 1996 and operates as an FOT through September of 1998. The evaluation of the TIC consists of four components, system reliability, communications interface, response time, and operator interface. This report focuses on the operator interface element.

The operator interface element has investigated the human element by considering the role of the operator in the flow of information through the TIC, the operators' tasks and responsibilities and the operators' physical environment. This report focuses on TIC operational effectiveness from an institutional perspective, identifying both areas of achievement as well as barriers to successful TIC operations. The evaluation was conducted through an analysis of responses to questions during in-person interviews of TIC operators, supervisors, and management.

While data was collected, processed, and disseminated to the public and private sectors, there were, nonetheless, constraints to operational effectiveness; most pre-dated the beginning of TIC operations but there were some that occurred during TIC operations. There were also, however, areas of success that contributed to operational effectiveness.

Prior to beginning operations detailed pre-project planning is essential, particularly vis-à-vis selection of a committed contractor(s), contractual agreements, data sources, and software interface design. During operations, key issues to consider include the hiring of staff with a high level of adaptability and flexibility to accommodate a changing environment, instituting staff quality control measures, and insuring a high level of communication among all staff.

Key Words: TravInfo, Field Operational Test, evaluation, traveler information center, advanced traveler information systems, operator interface, institutional issues

EXECUTIVE SUMMARY

TravInfo is a two year Field Operational Test (FOT) of advanced traveler information systems (ATIS) for the San Francisco Bay Area, sponsored by the Federal Highway Administration (FHWA). The project involves a public/private partnership which seeks to compile, integrate and broadly disseminate timely and accurate multi-modal traveler information through commercial products and services. The Traveler Information Center (TIC) is TravInfo's central information acquisition, processing, and dissemination hub and began operations in September 1996 and operated as an FOT through September 1998.

The evaluation of TravInfo consists of four major elements: (1) institutional, (2) technology, (3) traveler response and (4) network performance. The TIC study is part of the technology evaluation and consists of four primary elements: system reliability, communications interface, response time analysis and operator interface. System reliability examines system problems. The communications interface examines TIC data access on the part of both the public and private sectors. Response time measures the operations' processing time of incidents between entry into the TIC and dissemination to the public and private sector. Operator interface investigates the human element by considering the role of the operator in the flow of information through the TIC, the operators' tasks and responsibilities and the operators' physical working environment.

This report comprises the fourth and final part of the operator interface element. Previous parts comprised the information flow and task analysis and an investigation into the design of the operator interface and the physical working environment at the TIC and is documented in:

Miller M.A. and Loukakos, D. "TravInfo Evaluation (Technology Element) Traveler Information Center (TIC) Study (September 1996 - June 1997)", California PATH Working Paper, UCB-ITS-PWP-98-7, California PATH Program, University of California Berkeley, (1998).

Miller M.A. and Loukakos, D. "TravInfo Evaluation (Technology Element) Traveler Information Center (TIC) Study *Operator Interface Analysis-Phase III*", California PATH Working Paper, UCB-ITS-PWP-98-22, California PATH Program, University of California Berkeley, (1998).

This report assists in the understanding of TIC operational effectiveness from an institutional perspective, identifying both areas of achievement as well as barriers to successful TIC operations. The evaluation was conducted through an analysis of responses to questions during in-person interviews of TIC operators, supervisors, and management. The survey focused on the following six areas:

- TIC operational goals
- Areas of achievement
- Areas of concern/barriers to achievement

- Perceptions of TIC operations
- Organizational structure and partnerships
- Lessons learned

The commonly expressed TIC operational goal was to provide timely, complete, user friendly, and accurate information to the public and private sectors. Overwhelmingly, all survey respondents felt that the TIC was effective in achieving this operational goal, given the constraints and available resources. The evaluators agree with this assessment. Indeed, while data was collected, processed, and disseminated to the public and private sectors, there were, nonetheless, constraints to operational effectiveness most of which were out of TIC operations' control, i.e., the origins of these problems pre-dated the beginning of TIC operations. The primary constraints were: 1. uncertain availability of reliable and accurate automated data, 2. delays related to ongoing contractual issues between the Metropolitan Transportation Commission (MTC) and the system developer that impacted the timely implementation of system improvements and technical support, 3. a computer interface that inadequately met TIC operator's needs and responsibilities, and 4. a computer interface design with a lower level of automation than originally envisioned.

There were, nonetheless, problems impacting effectiveness that could have been addressed more completely and earlier by TIC operations. These problems were: 1. lack of operator quality control measures until the FOT was three-quarters complete and 2. insufficiently frequent communication among the TIC staff on subjects ranging from post-FOT status of TravInfo to operator suggestions for improvements. Furthermore, the timeliness of the information being disseminated by operators, a primary measure of its quality, will be assessed in a subsequent TIC evaluation report.

There were, however, also areas of success that contributed to operational effectiveness. Chief among these were: 1. quality of overall staff in terms of skills, attitude, and responsiveness to emergency conditions (BART¹ strike, El Niño flood period), 2. inter-organizational cooperation, in particular, between Metro Networks and the Voice Processing System developer, and 3. quality of certain data sources, namely, the California Highway Patrol Computer Aided Dispatch (CHP CAD), Metro Networks Airborne, and Metro Networks Instatrack Web page.

In making recommendations for improving operational effectiveness, it is useful to consider separately the pre-operational and operational environments. During the former, detailed pre-project planning is essential, particularly vis-à-vis selection of a dedicated contractor(s), contractual agreements, data sources, and software interface design. During operations, key issues to consider include the hiring of staff with a high level of adaptability and flexibility to accommodate an ever-changing environment, instituting staff quality control measures, and insuring a high level of communication among all staff.

¹ BART = Bay Area Rapid Transit

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1. INTRODUCTION

This report documents Phase IV of the Operator Interface component of the Traveler Information Center (TIC) evaluation. This work was not, however, originally planned for in the TIC evaluation plan (1). It resulted, rather, from having performed Phases I through III of the Operator Interface component (2, 3) and realizing that extending the Operator Interface investigation would further TIC evaluation objectives. This report evaluates the TIC's operational effectiveness from an institutional standpoint.

The remainder of this section provides background material on Phases I through III and discusses the specific objectives for this part of the evaluation before reporting on the findings.

1.1 Background and Objectives

The overall objective of the Operator Interface component of the TIC evaluation has been to assess TIC operational effectiveness. The human operator is integral to the functioning of the TIC. Thus, an evaluation of this human element and the extent to which the TIC supports human tasks is essential to obtain a complete picture of TIC operational effectiveness. Our evaluation strategy thus far has been to understand this human element, in the context of day-to-day operations, by analyzing the following three elements which have been documented in (2, 3).

- The role of operators in the flow of information throughout the TIC
- Operator tasks and responsibilities
- The operator working environment and associated interfaces between the operator and the TIC.

To provide a more complete picture we feel it is important to understand TIC operational effectiveness from a more general level, i.e., an institutional perspective, identifying both areas of achievement as well as potential technical and institutional barriers to successful TIC operations.

2. STUDY DESIGN

The evaluation was conducted through an analysis of responses to questions during in-person interviews (See Appendix A). Interviews were conducted with TravInfo operations staff at the TIC consisting of:

- Ten operators
- Two operations supervisors
- The Traveler Advisory Telephone Service (TATS) supervisor
- The TIC operations manager
- The Program manager

Interviews were also conducted with the Metropolitan Transportation Commission (MTC) and SRI, Inc. staff who have been involved with TIC operations at the management level of TravInfo². The interviews were conducted between April and June 1998 and typically lasted 60-75 minutes. Interviewee responses were placed into three groupings for analysis purposes: operators, supervisors, management. The management category includes both the operations contractor (Metro Networks), MTC, and SRI, Inc. interviewees. These groupings allow the findings to be compared between diverse groups of interviewees yet do not preclude a discussion of results that are generally common across all interviewees. Since confidentiality was guaranteed and the degree of attribution of results would be limited to groups of individuals, such as operators, and not individuals, it was hoped that the interviewees would provide candid responses.

3. STUDY FINDINGS

This section presents the results from the analysis of the completed surveys. The sub-sections correspond to the individual survey sections:

- TIC Operational Goals
- Areas of Achievement
- Areas of Concern/Barriers to Achievement
- Perceptions of TIC Operations
- Organizational Structure and Partnerships
- Lessons Learned

Survey responses have been grouped into three categories: operators, supervisors, and management, where management views consist of those from Metro Networks, MTC, and SRI, Inc. Each of the six sections contains a table(s) that summarizes responses corresponding to that part of the survey. Also included in each table, where applicable, is the number of interviewees who mentioned a particular topic. Since each interviewee may have mentioned multiple topics, the sum of each of these numbers does not necessarily sum to the number of interviewees.

3.1 TIC Operational Goals

The objective of this part of the survey was to determine the goals of TIC operations. Specific questions focused on the effectiveness of achieving these goals, and their appropriateness. The provision of timely, complete, and accurate information to the traveling public was the dominant operational goal stated by interviewees across all groups (See Table 1). A few operators and supervisors mentioned servicing the private sector: 1. providing a service for Registered Participants, 2. assisting in the development of private sector products and services, and 3.

² MTC is one of the three lead public agencies on TravInfo's Management Board, its public sector governing body. Other Project Partners include Caltrans (District 4), and the California Highway Patrol (CHP-Golden Gate Division). SRI, Inc. of Palo Alto, California is under MTC contract to provide technical advice and consultation throughout the TravInfo Field Operational Test period.

assisting in the development of private/public partnerships. With almost unanimity, the interviewees felt these operational goals were appropriate. Respondents, however, stated that operational effectiveness was constrained by the tools available such as the computer interface, data sources, and occasional human resource problems. This response was summed up succinctly with the often used phrase of “Yes, with reservations”.

Table 1: Summary of Responses to “TIC Operational Goals”

ISSUE	OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
Goals	Provide timely, complete, user friendly, and accurate information to the public; Provide a service to Registered Participants	Provide timely, complete, user friendly, and accurate information to the public; Assist in development of private sector product lines and services, help develop public/private partnerships; Be central clearinghouse for traveler information.	Provide timely, complete, user friendly, and accurate information to the public
Effectiveness	Yes, with reservations	Yes, with reservations	Yes, with reservations
Appropriateness	Yes	Yes	Yes

3.2 Areas of Achievement

The objective of this section of the survey was to identify areas of success that have helped achieve TIC operational goals and reasons for such success during the TravInfo Field Operational Test (FOT). Table 2 shows those areas that have contributed to the achievement of TIC operational goals. Note that the number

Definitions of terms used in Table 2:

- *Staff*: general job performance and quality of operations staff
- *Interagency/organizational cooperation*: relationship between TIC operations and agencies such as Caltrans, the CHP, and MTC and between TIC operations and organizations such as contractors.
- *Network coverage*: extent of Bay Area roadway system covered by TravInfo
- *Staff independence*: overall feeling of autonomy the TIC operators have on the job
- *Staff quality control*: means with which the operations’ staff job performance is monitored
- *Responsive management*: TIC operations management (Metro Networks) responsiveness to operator needs
- *Marketing*: Methods used to advertise and promote TravInfo
- *Emergency response*: Operators’ performance during times of heightened importance, such as the BART³ strike and the El Niño generated floods

³ BART = Bay Area Rapid Transit

- *Data entry tools*: Availability of tools to assist in the data entry function, e.g., macros (CHP Computer Aided Dispatch (CAD) terminal) and new equipment
- *Overall work plan*: FOT and post-FOT plan/vision for TravInfo operations

Table 2: Summary of Responses to “Areas of Achievement”

ISSUE	OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
Areas of success to help achieve TIC operational goals	<ul style="list-style-type: none"> -Staff (6) -Data quality/sources (4) -Interagency/organizational Cooperation (3) -Network coverage (2) -Staff independence (1) -Staff quality control (1) -Responsive management (1) -Marketing (1) -Data dissemination (1) -Emergency response (1) -Data entry tools (1) -Software improvements (1) 	<ul style="list-style-type: none"> -Staff (3) -Interagency cooperation (2) -Physical working environment (2) -TATS system (2) -Software improvements (1) 	<ul style="list-style-type: none"> -Interagency/organizational cooperation (4) -Data quality/sources (3) -Staff (2) -Staff quality control (2) -Emergency response (2) -TATS system (1) -Learning opportunities vis-à-vis institutional relationships (1) -Overall work plan (1) -Software improvements (1)

While overall there are numerous topics mentioned, there are few mentioned by a majority of the interviewees for the Operator and Management groups. For example, only “Staff” and “Interagency/organizational cooperation”, are mentioned by greater than a majority of the interviewees from the Operators and Management groups, respectively. The stated views are more scattered than concentrated among the respondents. “Staff” and “Interagency/organizational cooperation” are the two topic areas common to each of the three sets of interviewees. “Staff” is the number one category for the Operators and Supervisors. This response makes sense given that these two groups comprise the great majority of the TIC staff and that the human element is of paramount importance for TIC operations. Management, however, rates “Interagency cooperation” as its highest ranking achievement area, which again seems intuitive since one would expect interagency relationships to be more visible and prominent on management’s “radar screen” than for operators.

The top three areas of success or achievement are: 1. Staff (11 out of 19 respondents), 2. Interagency/organizational cooperation (9 out of 19 respondents), and 3. Data quality/sources (7 out of 19 respondents). Reasons given by respondents for success in these areas include:

- Staff: TIC experience and high quality staff overall, good hiring decisions, teamwork
- Interagency/organizational cooperation: commitment on part of Voice Processing System (VPS) contractor, commitment on part of specific project partners, establishing and

maintaining good inter-personal relationships, TIC staff dedication to work with other agencies

- Data quality/sources: resourceful staff, availability of Metro Networks data (Airborne, Instatrack Web page)

3.3 Areas of Concern/Barriers to Achievement

The objective of this section of the survey was to identify technical and institutional barriers to the achievement of TIC operational goals and actions taken to resolve these problems. Table 3 shows those areas that interviewees feel have presented barriers to the achievement of TIC operational goals.

Definitions of terms used in Table 3:

- *Management relations*: Staff relationship with TIC operations management (Metro Networks)
- *Technical support*: Refers to having in-house support of a computer system administrator
- *Level of automation*: Level of automation was not what was originally envisioned
- *Operator performance*: Refers to poor work performance of specific operators
- *Source code ownership*: Refers to the ownership of TransView computer software source code
- *Relationship with system developer*: Refers to relationship between MTC and system developer/integrator including the state of the computer software system.

Table 3: Summary of Responses to “Areas of Concern/Barriers to Achievement”

ISSUE	OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
Technical & institutional problems	-TIC computer system/interface (9) -Management relations (7) -Data sources (6) -Technical support (3) -TATS system (3) -Operator performance (3) -Physical working environment (2) -Funding uncertainty (1) -Level of automation (1) -Too much paperwork (1) -Marketing effectiveness (1) -Public agency bureaucracy (1)	-TIC computer system/interface (2) -Data sources (2) -Public agency bureaucracy (2) -Source code ownership (2) -Level of automation (1) -Physical working environment (1) -Relationship with system developer (1) -TravInfo management structure (1) -Operator performance (1) -Marketing effectiveness (1)	-Data sources (6) -TIC computer system/interface (4) -Relationship with system developer (3) -Public agency bureaucracy (2) -Level of automation (2) -Private sector involvement (1) -TravInfo management structure (1) -Metro Networks management (1)

Several topic areas are common across all three interviewee groups: “TIC computer system/interface”, “Data sources”, “Level of automation”, and “Public agency bureaucracy”. In contrast to Table 2, several topic areas were mentioned by a majority of interviewees for each group. “TIC computer system/interface” is mentioned by 90%, 66.7%, and 66.7% of the interviewees from the Operators, Supervisors, and Management groups, respectively. “Data sources” is mentioned by 60%, 66.7%, and 100% of the interviewees from the Operators, Supervisors, and Management groups, respectively. “Management relations” is another topic area mentioned by greater than a majority of Operator group interviewees and concerned primarily a communications gap with TIC operations management (i.e., operators’ being kept fully informed on issues, e.g. funding issues and future viability of TravInfo and soliciting operators’ input on how to improve operations). “Public agency bureaucracy” (and associated delays in making necessary changes) and “Source code ownership” are additional topic areas mentioned by two of the three Supervisors. Related to the latter issue is the fact that 50% of Management mentioned “Relationship with system developer” as a problem area.

The top four areas of concern are: 1. TIC computer system/interface, 2. Data sources, 3. Management relations, and 4. Relationship with System contractor (legal/contractual issues). Actions taken to try to resolve these issues include:

- TIC computer system/interface: signing of a maintenance contract and hiring of an in-house system administrator
- Data sources: working with Caltrans to improve quality of existing loop detectors and issuance of Request For Proposals (RFP) to acquire new data sources
- Management relations: soliciting more operator input, e.g., during TIC relocation
- Relationship with System Developer: signing of a maintenance and software licensing contracts and hiring of an in-house system administrator

3.4 Perceptions of TIC Operations

The objective of this section of the survey was to assess perceptions of TIC operations and how they may have changed during the FOT, whether there is an overall project vision for post-FOT TIC operations, and an understanding of who has benefited from TravInfo. Table 4 summarizes the responses to these inquiries.

Table 4: Summary of Responses to “Perceptions of TIC Operations”

ISSUE	OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
Change in level of motivation and enthusiasm	-Decreased (6) -Generally stable ⁴ (3) -Increased (1)	-Decreased (2) -Increased (1)	-Generally stable (3) -Increased (2) -Decreased (1)
Vision for post-FOT TIC operations	-No (4) -Don't know (3) -Yes (3)	-Yes (2) -No (1)	-Yes (5) -Don't know (1)
Who has benefited	-Public (9) -Private (1) -Don't know (1) -TRW (1)	-Public (3) -Private (1) -Transit Service Providers (1)	-Public (6) -Private (6)

Differences exist among the three groups with respect to the change in the level of motivation and enthusiasm. For the Operators, Supervisors, and Management groups, 90% (60%), 66.7% (66.7%), and 66.7% (16.7%) of the respondents indicated either a “Generally stable” or “Decreased” (“Decreased” only) level of motivation and enthusiasm, respectively. Interviewees generally referred to the areas of concern and barriers to achieving TIC operational goals (Table 3) to explain the reduction in their motivation and enthusiasm levels.

The “Vision” category in Table 3 is also revealing in that 70% of the operators either say there is no vision or don't know of one, a considerably greater percentage for this group than for the other two groups. The reasons for such a large percentage are, in the evaluators' opinion: 1. operators' “Management relations” concern (Table 3) and sense of a communications gap with management and 2. some operators simply do not care about such issues.

Table 4 indicates that while all but one respondent believed the public has benefited, benefits to the private sector are mostly mentioned by Management (1 out of ten Operators, 1 out of three Supervisors, and each of the six Management interviewees). The very low “Private sector” percentage for Operations, 10%, could be due to the fact that operators naturally focus on TATS and there has been little contact between the operators and private sector representatives, i.e. Registered Participants (RPs) or Information Service Providers (ISPs), except during tours of the TIC. However, only one-third of the Supervisors mention the Private sector as having received benefits from TravInfo and yet the Supervisors have more contact with them. One explanation for why the Management group mentioned both the Public and Private sectors is that they have a broader view of the entire TravInfo setting. Another explanation for the stark difference in responses between Operations and Management may essentially be due to differences in their perception of the project's impact and vision for post-FOT deployment.

⁴ “Generally stable” allows for some increases and decreases but overall a fairly stable level of motivation and enthusiasm.

3.5 Organizational Structure and Partnerships

The objective of this section of the survey was to assess the effectiveness of the organizational structure, both for TravInfo and the TIC, in achieving the TIC’s operational goals. There were also questions pertaining to the roles of the public and private sectors. Tables 5a through 5d summarize the results of these inquiries. Given the primary focus of the operator work duties, many operators are not familiar with the issues raised in this section of the survey. This is reflected by the volume of “Don’t know” responses by operators.

3.5.1 TravInfo Organizational Structure

All three groups are of the opinion that the TravInfo organizational structure detracted from the TIC achieving its operational goals (Table 5a). In fact, 50%⁵, 100%, and 33.3% of the operators, supervisors, and management, respectively, expressed this view.

Table 5a: Summary of Responses to “TravInfo’s Organizational Structure”

ISSUE	OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
TravInfo’s organizational structure	-Detracts (5) -Don’t know (4) -Enhances (1)	-Detracts (3)	-Detracts (2) -No effect (2) -Enhances & detracts (1) -Enhances (1)
Roles of public & private organizations	-Don’t know (4) -Appropriate (3) -Not appropriate (3)	-Somewhat appropriate (2) -Not appropriate (1)	-Somewhat appropriate (4) -Appropriate (2)

The main reason for such percentages was that the organizational structure was felt to be too bureaucratic and contributed to delays in decision-making. The arrangement of having the day-to-day operations run by a private contractor (Metro Networks) with managerial oversight provided by the public sector (Management Board (MB)/MTC) has not always produced the best results. An often-heard comment was to have Metro Networks be given more independence in its running of the TIC to improve this situation. Reasons for this include: 1. aspects of the private and public sectors such as their overall agendas, work cultures, and business priorities differ and do not always mesh well; 2. the MB is removed from daily operations, which could contribute to less than optimal decision-making, (Improved communication between contractor and manager could help this situation); 3. some MB members do not recognize their own high stake in the success of TravInfo, do not take it as seriously as they should, and hence do not contribute as

⁵ Of those operators who were knowledgeable of this issue, five out of six stated that TravInfo’s organizational structure detracted from achieving the TIC’s operational effectiveness.

much as possible (4). These comments and concerns reflect an uneasiness with having both private and public sectors so actively engaged in management and operations.

Despite these organizational weaknesses, strengths were also noted. Having the participation and official backing of agencies such as the CHP and Caltrans, is very important to the future of the project. As stated above, it was essential to have public involvement to kick things off as well as to help get data. Other strengths mentioned included: 1. the small number of voting members on the MB makes it easier to achieve consensus, 2. the MB’s open forum to express ideas as well as the ISP Forum helps reach consensus, 3. the MB’s diverse membership provides the opportunity to learn about potential resources for the project.

Overall, there is a consensus that the roles of the private and public sectors range from “somewhat appropriate” to “appropriate”. The following improvements were suggested:

- Increased participation of the private sector, i.e., more ISPs, as data disseminators. However, many of the interviewees, especially Management, recognized that given the present overall data quality, it would be difficult to attract additional ISPs.
- Increased effectiveness and efficiency on the part of the public sector, i.e., streamlining bureaucracy (See Table 3).
- Increased role of the private sector operations contractor in post-FOT TIC management.

3.5.2 TIC Organizational Structure

With respect to the TIC’s organizational structure, i.e., the three-level deep hierarchy of operators, supervisors, and managers, there were differences in the responses across the three major interviewee groups (Table 5b). Operators were fairly evenly split on the issue of whether the TIC’s organizational structure enhanced or detracted from the fulfillment of the operational goals. The supervisors and management strongly felt that the TIC’s organizational structure enhanced operational goals. Yet, there were also common suggestions as to how to improve operational effectiveness.

Table 5b: Summary of Responses to “TIC’s Organizational Structure”

ISSUE	OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
TIC’s organizational structure	-Detracts (4) -Enhances & detracts (4) -Enhances (2)	-Enhances (3)	-Enhances (4) -Detracts (1) -Abstain/No answer (1)
TIC structural changes to enhance operational effectiveness	-Yes (7) -No (3)	-No (2) -Yes (1)	-No (2) -Yes (2) -Abstain/No answer (2)

The following changes were suggested by the operators to improve operations and make it more effective with numbers 1 through 3 the most frequently heard comments: 1. Improve communication among all staff members, 2. Supervisors should have more technical knowledge and expertise, 3. Supervisors' primary responsibility should be supervising the operators, which they cannot always do because they have numerous responsibilities, 4. Have clearer and consistent lines of task responsibility for staff, 5. Increase decision-making authority for on-site staff including operators who are closer to the situation, i.e. fewer layers of decision-making bureaucracy, 6. Need in-house technical staff, i.e., computer system administrator, 7. Have supervisors on weekend duty, 8. Maintain operator quality control.

The following changes were suggested by the supervisors to improve operations: 1. Maintain operator quality control, 2. Have in-house technical staff, 3. Have improved communication among all staff members.

The following changes were suggested by the management, i.e., the survey respondents grouped into the Management category (See Section 2), to improve operations with numbers 1 and 2 the most frequently heard comments: 1. Current organizational structure, while necessary now due to preponderance of the human/manual element in operations, could be streamlined, i.e., become less top heavy, as system becomes more stable, enhancements are made, and level of automation increases, 2. Have improved communication among all staff members, 3. More decision-making authority for on-site staff including operators who are closer to the situation, and 4. Improved enforcement of Metro Networks contractual agreements.

3.5.3 Operational Responsibility Post-FOT

With respect to the operational responsibility of the TIC after the FOT concludes, clear differences exist among the three interviewee groups (Table 5c). The following percentages of operators, supervisors, and management expressed the desire to have the TIC privately operated and managed: 60%, 66.7%, and 0%, respectively. Conversely, the following percentages of operators, supervisors, and management felt that operational responsibility should remain as is with the current private/public division: 10%, 33.4%, and 100%, respectively. Such results are not surprising and could reflect, in the case of the operators' views, incomplete information about such topics (See Section 3.3). Otherwise, they would realize that continued public financial support either directly or from in-kind contributions, at least in the near term, is necessary. Yet, public financial support does not necessarily have to result in public decision-making authority.

Table 5c: Summary of Response to “TIC’s Operational Responsibility”

ISSUE	OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
TIC operational responsibility in post-FOT period	-Metro Networks/Private sector (6) -Don’t know (2) -Continue as is (Metro Networks/ MTC) (1) -MTC/Public sector (1)	-Go private (2) -Continue as is (Metro Networks/MTC) (1)	-Continue as is (Metro Networks/MTC) (6)

3.5.4 Relationship with Public and Private Sectors

With respect to the level of cooperation between the TIC and public agencies it interacts with, the further away from the day-to-day operations one gets, the higher the assessment tends to be (Table 5d). The lowest assessment by any interviewee was “Average”. The percentage of “Average” assessments were 60%, 33.4%, and 16.7% for the operators, supervisors, and management, respectively. Conversely, the percentage of assessment of “Good” or better was for the operators, supervisors, and management, 30%, 66.7%, and 83.3%, respectively.

Table 5d: Summary of Responses to “Organizational Relationships and Partnerships”

ISSUE	OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
Cooperation between TIC and public agencies	-Average (6) -Good (3) -Don’t know (1)	-Good (2) -Average (1)	-Good (3) -Very good (2) -Average (1)
Relationship between TIC and RPs	-Don’t know (10)	-Good (2) -Don’t know (1)	-Good (4) -Average (1) -Don’t know (1)

Suggestions for improvement mentioned by operators included: 1. the need for improved communication between the TIC and members of public agencies, especially those who provide information and 2. the need for a better process to get information. Currently operators say they continuously must “chase down” information which makes their job more difficult. The only specific improvement mentioned by the supervisors was for additional TIC visits by MTC to more fully understand how traffic reporting is performed and its dynamic nature. Members of the management group mentioned: 1. Relocation of TIC away from immediate proximity to TMC could initially pose a problem, 2. Agencies should forward information to the TIC instead of the TIC having to track it down.

With respect to the relationship between the TIC and the Registered Participants it interacts with, operators unanimously answered “Don’t know” while two-thirds of supervisors and management assessed this relationship as “Good”. The only matters mentioned were: 1. Improved data for RPs is absolutely necessary, and 2. Better communication between the TIC and RPs will help RPs understand the process of traffic reporting and the reasons behind actions taken by the TIC.

3.6 Lessons Learned

The objective of this part of the survey was to elicit lessons learned over the course of the FOT. “Lessons learned” topic areas have been organized into categories which are listed alphabetically in Table 6 for each interviewee group. The number in parentheses after each topic area is the number of interviewees within that group who mentioned that topic.

Further explanation of terms used in Table 6:

- “Insure sufficient rights to software source code”:
TRW, the system developer, owns the software and MTC has a license to use it. That license also gives MTC the right to make any modifications that it desires. If MTC makes modifications that are considered “derivative works”, then TRW owns them. If MTC adds something new, then it owns the new software.
- “Need more effective TIC management”:
It was felt by Operators that members of TIC management (Metro Networks) should do some things differently to increase likelihood of a more efficient and effective operation, e.g., enhance communication among all staff.
- “Improve division of workload among operators”:
There are four operator workstations: Three geographic positions and one position focusing on recurring congestion, called the “slowdown position”. The slowdown position experiences a greater workload than the geographic workstation positions.
- “Full private sector operation of TIC”:
The TIC’s day-to-day operations would be run by Metro Networks or another private sector contractor.
- “Consider integration of TIC/TMC operations”:
The TMC is Caltrans District 4’s Transportation Management Center. The TIC and the TMC were adjacent to each other and separated by a glass partition for all but two months of the two year FOT at which point the TIC moved to another location in the same building.
- “Obtain better commitment of system developer”:
It was felt that the system developer needed to improve its overall level of dedication to the project.
- “Manage expectations better, and realize limitations of technology”:

In other words, it is important to understand that problems will occur and changes will be necessary in the Field Operational Test setting of TravInfo.

Table 6: Summary of Responses to “Lessons Learned”

OPERATORS (10)	SUPERVISORS (3)	MANAGEMENT (6)
<p>Financing -Include private funding sources either from start or after operations (1)</p> <p>Inter-agency/organizational cooperation -Insure more private sector support (1)</p> <p>Legal/Contractual -Insure sufficient rights to software source code (1)</p> <p>Marketing -Improve marketing plans (2) -Know your target market before you start (1)</p> <p>Organizational -Need more effective TIC management (5) -Improve communication among different levels of TIC staff (4) -Insure hiring of quality staff (4) -Have fewer layers in the organizational structure (2) -Have staff quality control mechanisms (2) -Solicit operator input for system improvements (1) -Perform problem resolution promptly (1) -Have flexible and adaptable personnel (1) -Devote more time to satisfy ISP requests (1) -Improve operator training procedures (1) -Improve division of workload among operators (1) -Have appropriate level of in-house technical support staff (1)</p> <p>Planning -Insure quality of data processing software before purchase (2) -Make sure promised data is delivered (2)</p> <p>Post-FOT Deployment -Full private sector operation of TIC (1)</p> <p>Technical: -Have high quality tools for data collection and processing (3)</p>	<p>Financing -Monitor costs through careful financial planning (1)</p> <p>Inter-agency/organizational cooperation -Enhance public sector support, especially from Transit Service Providers (1)</p> <p>Legal/Contractual -Insure sufficient rights to software source code (2)</p> <p>Marketing -Increase funding (1)</p> <p>Organizational -Improve communication among TIC staff, yet balance this against other TIC priorities (1) -Have flexible and adaptable personnel (1) -Have appropriate level of in-house technical support staff (1)</p> <p>Planning -Good pre-project software planning (1)</p> <p>Post-FOT Deployment -Full private sector operation of TIC (1)</p> <p>Technical: -Insure high quality computer interface design (1)</p>	<p>Inter-agency/organizational cooperation -Do not ignore institutional issues arising within individual and between project partners (1) -Consider integration of TIC/TMC operations (1) -Obtain better commitment of system developer (1)</p> <p>Legal/Contractual -Insure sufficient rights to software source code (1)</p> <p>Organizational -Have appropriate level of in-house technical support staff (3) -Insure hiring of quality staff (1) -Improve communication among different levels of TIC staff (1) -Have flexible and adaptable personnel (1)</p> <p>Planning -Insure quality of data processing software before purchase (4) -Study carefully user interface features prior to going live to help insure a better user interface (3) -Be aware of the risk involved when relying on other sources (agencies) for data. The levels of contribution toward a project may differ by agency/organization (2) -Recognize value of implementing a project in incremental stages (1) -Good pre-project planning to insure good hiring (1) -Insure appropriate pre-project assessment of technical needs (1) -Be wary of purchasing software developed for other applications⁶ (1) -Develop Operations Procedures Planning document early on in the project (1) -Manage expectations better and realize limitations of technology (1)</p> <p>Technical: -Need improved integration and automation of system components (1)</p>

⁶ The TIC software, TransView, was initially developed for another application.

The Operators' and Supervisors' lessons learned expectedly focused within the Organizational category, and Management's focus was placed primarily in the Planning category, but also in the Organizational area. It is also interesting to note what was either not or hardly mentioned at all: 1. There were few lessons learned mentioned in the Technical category⁷ and 2. There was no mention of Financing-, Marketing- and Post-FOT Deployment-related topics by the Management group. The latter result could be due to Management's representatives having for the last year worked intensively in all three of these areas, whereas, the other two groups, especially Operators, have hardly been involved with them at all.

There were few widely held "lessons learned" topics, that is, mentioned by at least a majority of interviewees from each group. Operators mentioned only the following topic: "Need more effective TIC management". Supervisors also mentioned only one topic: "Insure ownership of software source code". Management mentioned the following three topics: 1. "Insure quality of data processing software before purchase", 2. "Careful study of user interface features prior to going live to help insure a better user interface", and 3. "Have appropriate level of in-house technical support staff". Other frequently mentioned topic areas include "Improve communication among different levels of TIC staff," (suggested by all three groups) and "Insure hiring of quality staff" (suggested by Operators and Management).

The following topic areas were common across all three groups of interviewees, making them, in the evaluators' opinion, of some significance:

- Insure ownership of software source code
- Have appropriate level of in-house technical support staff
- Have flexible and adaptable personnel
- Improve communication among different levels of TIC staff
- Insure quality of data processing software before purchase/ Insure high quality computer interface design

The following topics, which cover some of the most widely held lessons learned within an individual group and across groups, warrant additional discussion:

- Interface design
- Data
- TIC operations staff
- Contractual agreements: software source code and technical needs

Interviewee concerns of the TIC's computer software program, TransView, and its associated interface were validated by a previous evaluation report (3). Interviewee remarks are justified

⁷ A different grouping of the items in Table 6 could, of course, have resulted in a rearrangement of the lessons learned per category.

and validated by the evaluation team's analysis. This previous report documented the views and experiences of operators and supervisors, not management. Here, members of management are expressing the same concerns about the computer interface design.

A common view is that there has been an over reliance on a single data source (loop detectors via the TOS). Such over reliance on a single agency for data of questionable quality and reliability has already been documented (2, 4). This has resulted in an incomplete coverage of the Bay Area freeway network relative to speed and congestion data. Doubts about the reliability of data should be planned for and incorporated into project planning, including considering the possibility of delaying project implementation until such problems are resolved. A risk assessment of data reliability should be made.

Every group interviewed felt that communication among all levels of TIC staff needed improvement. This view was felt particularly strongly by some operators who sensed they had not been sufficiently informed of TravInfo developments. The fact that the FOT has a two-year lifetime has contributed to this desire for more information because until there were guarantees about its continuation, TravInfo could have terminated at the conclusion of the FOT.

Problems with specific operators as well as with supervisors and management were mentioned. The hiring of staff has not always been consistently good, i.e. there has not always been a consistently high quality of staff hired. This was mentioned not only by management, where you might expect to hear it but also by operators (40% of operators). The operators, however, are more familiar and much closer to the situation. Operator quality control that is comprehensive and thorough should have been instituted earlier in the test period as it only began approximately March 1998, a year and a half after TravInfo began operations.

The software licensing and maintenance contracts were signed in November, 1997. The software licensing contract, that specified the contractual agreement regarding ownership and use of the TransView software, was an amendment to the original system development contract. The signing of the maintenance contract allowed a technical support person⁸ to work at the TIC beginning March, 1998 and led to operational improvements. Signing of these contracts, however, was one year and eight months after delivery of the product and one year and two months after the start of the FOT. The fact that it took so long to reach such contractual agreements contributed to delays in instituting TIC technical improvements and in obtaining technical support. An important lesson learned has been the importance of having, to the maximum extent possible, highly detailed contracts and optimal planning for potential contingencies to avoid such issues.

The post-FOT TravInfo environment and other Traveler Information Center projects are two settings within which these lessons learned may be applied. While each of the lessons learned listed in Table 6 should be reviewed to assess its usefulness to assist future Traveler Information Center projects, some lessons cannot be used in the post-FOT deployment setting of TravInfo as

⁸ A TRW contract employee

it is frankly too late to do anything. Examples of such lessons relate to the system developer and include: 1. Insuring ownership of TransView software source code, 2. Obtain better commitment on the part of system developer, and 3. Be wary of purchasing software developed for other applications.

4. CONCLUSIONS

The commonly expressed TIC operational goal was to provide timely, complete, user friendly, and accurate information to the public and service to the private sector. Overwhelmingly, all survey respondents felt that the TIC was effective in achieving this operational goal, given the constraints and available resources. While data was collected, processed, and disseminated to the public and private sectors, there were, nonetheless, constraints to operational effectiveness most of which were out of TIC operations' control, i.e., the origins of these problems pre-dated the beginning of TIC operations. The primary constraints were: 1. uncertain availability of reliable and accurate automated TOS data, 2. delays related to ongoing contractual issues between the MTC and the system developer that impacted the timely implementation of system improvements and technical support, 3. a computer interface that inadequately met the TIC operator's needs and responsibilities, and 4. a computer interface design with a lower level of automation than originally envisioned.

There were, nonetheless, problems impacting effectiveness that could have been addressed more completely and earlier by TIC operations. These problems were: 1. comprehensive and thorough operator quality control measures not implemented until the FOT was three-quarters complete and 2. insufficiently frequent communication among the staff on subjects ranging from post-FOT status of TravInfo to operator suggestions for improvements in operations. Furthermore, the timeliness of the information being disseminated by operators, a primary measure of its quality, will be assessed in a subsequent TIC evaluation report.

However, there were also areas of success that contributed to operational effectiveness. Chief among these were: 1. quality of overall staff in terms of skills, attitude, and responsiveness to emergency conditions (BART strike, El-Niño flood period), 2. Interagency/organizational cooperation, in particular, between Metro Networks and the VPS contractor, and 3. quality of certain data sources, namely, the CHP CAD, Metro Networks Airborne, and Instatrack Web page.

In making recommendations for improving operational effectiveness, it is useful to consider separately the pre-operational and operational environments. During the former, detailed pre-project planning is essential, particularly vis-à-vis selection of a dedicated contractor(s), contractual agreements, data sources, and software interface design. During operations, key issues to consider include the hiring of staff with a high level of adaptability and flexibility to accommodate a changing environment, instituting staff quality control measures early on in the project, and insuring a high level of communication among all staff.

5. REFERENCES

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6. APPENDICES

This section contains the following Appendix:

Appendix A: Operator Interface Survey

APPENDIX A

OPERATOR INTERFACE SURVEY

MOTIVATION

The overall objective of the Operator Interface component of the TIC evaluation is to assess TIC operational effectiveness. The human operator is integral to the functioning of the TIC. Thus, an evaluation of this human element and the extent to which the TIC supports human tasks is essential to obtain a complete picture of TIC operational effectiveness. Our evaluation strategy thus far has been to understand this human element, in the context of day-to-day operations, by analyzing:

- the role of operators in the flow of information throughout the TIC
- operator tasks and responsibilities
- the operator working environment and associated interfaces between the operator and the TIC.

We have interviewed TIC operations' staff and the supervisors who are most closely associated with day-to-day operations. Operational effectiveness must also be examined at a more general level to identify both areas of achievement as well as potential technical and institutional barriers to successful TIC operations. The following survey instrument was developed and will be implemented to investigate these issues from such a higher-level perspective.

SURVEY

Scripted Introduction

The University of California is conducting interviews with TIC personnel to assess overall TIC operational effectiveness. Information that you provide will be used to improve TIC operations, but will be kept confidential.

I. Introduction: TIC Operational Goals

Objective: To determine what the goals of TIC operations are.

- a. What do you believe are the TIC operational goals? [Note to interviewer: if multiple goals are listed, ask interviewee to prioritize in order of importance]

b. How effective overall has the TIC been in achieving its operational goals?

c. Are these goals appropriate? If not, why not, and what should the goals be?

II. Areas of Achievement

Objective: To determine the degree to which specific TIC operational goals have been achieved and other successes during the FOT.

a. In your opinion, what are some areas (*Examples not to be read out are:* data quality, network coverage, institutional partnerships, software improvements, working environment, automation level, work prioritization) of success that have helped achieve TIC operational goals?

b. For each of these areas, please describe the degree of success achieved.

c. For each of these areas, what do think are the most important reasons for such success?

III. Areas of Concern/Barriers to Achievement

Objective: To identify technical and institutional concerns that have presented barriers to the achievement of TIC operational goals during the FOT.

a. In your opinion, what have been the most significant technical and institutional problems (*Examples not to be read out are: data quality, network coverage, institutional partnerships, software improvements, working environment, automation level, work prioritization*) during your tenure at the TIC?

- b. What actions, if any, have been taken to resolve each of these problem areas? Has the resolution been satisfactory? (yes, no, why?)

IV. Perceptions of TIC Operations

Objective: To assess perceptions of TIC operations and how they may have changed over time

- a. Since the beginning of TIC operations (or since the beginning of your tenure at the TIC), has your motivation and/or enthusiasm changed in any way? Why do you think so?

- b. With the FOT concluding in six months, do you think there is a clear vision for post-FOT TIC operations? If yes, what is it?

- c. In your opinion, who has benefited from the traveler information provided by TIC operations and how?

V. Organizational Structure and Partnerships

Objective: To assess the effectiveness of the organizational structure, both of TravInfo and of the TIC, in achieving the TIC's operational goals

Would you like me to review TravInfo's organizational structure before proceeding?

1. Yes (if yes, review via script)
2. No (if no, proceed)

Script for organizational structure:

TravInfo is run by a Management Board which is responsible for the overall management of the project, and provides direction to the Metropolitan Transportation Commission (MTC) project management team. The Management Board is composed of representatives from the following public agencies: MTC, the California Department of Transportation (Caltrans) District Four, and the Golden Gate Division of the California Highway Patrol (CHP), as well as representatives from TravInfo's funding agencies and California Partners for Advanced Transit and Highways (PATH), the project's independent evaluator.

A key characteristic of TravInfo from the beginning was its emphasis on a public/private partnership. There have been five consultants intimately involved as project partners. TRW was responsible for creating the system architecture and developing the system. SRI International has

- e. In the event that TravInfo will continue past the test period, who do you believe should assume responsibility for operation in the post-FOT period? Why?

- f. How would you describe the level of cooperation between the TIC and the public agencies it interacts with? If needed, can you suggest any improvements?

- g. How would you describe the state of the relationship between the TIC and the Registered Participants it interacts with? If needed, can you suggest any improvements?

VI. Lessons Learned and Recommendations

Objective: To elicit recommendations for the improvement of TIC operations

- a. Looking back on TIC operations from the time they began (or since the start of your tenure at the TIC), what do you feel are the most important lessons learned about running an organization such as the TIC?

b. Do you have any remaining concerns or comments on TIC operations?