Application of Data Processing Techniques to the Monitoring of Transit System Performance in San Diego

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ABSTRACT

The complexity of monitoring transit operator performance in a multiple-operator system led the San Diego Metropolitan Transit Development Board (MTDB) to apply data processing techniques to its analysis. In this paper are described the multiple-operator and financial assistance situation in the MTDB area and the adaptation of computer capability to it. Included are discussions of the data files and reports created, the type of computer services used, use of the reports and data base, and future conversion to an in-house computer. It is concluded that the use of data processing techniques has greatly enhanced MTDB's capability to monitor expenditures of transit assistance funds and has increased the administrative efficiency of staff.

The San Diego Metropolitan Transit Development Board (MTDB) area of jurisdiction includes the southern urbanized portion of San Diego County, an area of 450 mi^2 with a 1982 population of 1.3 million. Transit service in the MTDB area is provided by 14 operators, listed in the following table by type of service:

Type of Service	Operator
Light rail	San Diego Trolley
Fixed-route bus	County Transit System Express Bus
	County Transit System Suburban Bus
	National City Transit
	San Diego Transit
	South Coast Organization Operating Transit
	Strand Express
Dial-a-ride	
General public	El Cajon Dial-a-Ride
	La Mesa Dial-a-Ride
	Lemon Grove Dial-a-Ride
Elderly and handicapped	Chula Vista Handytrans
	County Transit System Wheels
	San Diego Dial-a-Ride

MTDB serves as the coordinating agency for these varied services with the objective of having a single, unified transit system.

Many of MTDB's activities in the following areas have been computerized:

- Accounting and financial management,
- Operator performance monitoring,
- Operating and capital project programming,
- San Diego Trolley fare evasion records,
- Engineering records,
- Transit pass sales, and
- Graphics.

This paper focuses on operator performance monitoring.

MTDB ADMINISTRATIVE RESPONSIBILITIES

Funding for transit operations is provided by a combination of passenger fare revenue and local, state, and federal assistance (only one operator in the area is eligible for federal operating funds). Operating assistance is provided primarily by California State Transportation Development Act (TDA) monies that are available to each of the nine jurisdictions on the basis of its population. Each jurisdiction contracts with one or more transit operators for service. On the basis of the contracts, transit operators make claims on jurisdictions' TDA monies and these claims are reviewed and approved by MTDB.

California state law makes MTDB responsible for the maintenance of a collective fare revenue-to-operating cost ratio of 31.9 percent by its fixed-route and general public dial-a-ride operators in order to be eligible for TDA monies. Therefore MTDB monitors the performance of its operators for two specific purposes: (a) to ensure that TDA funds will not be exhausted before the end of the fiscal year and (b) to assure maintenance of the required fare revenue-to-operating cost ratio.

DATA PROCESSING IMPLEMENTATION

Before the introduction of data processing techniques, monthly and quarterly monitoring of operator performance and the TDA spending rate was performed on an irregular basis. As a result, funding problems that required immediate action often arose near the end of the fiscal year with little or no warning. The complexity of multiple-operator performance monitoring led MTDB staff to explore the possibility of adapting computer capability to the tasks in August 1981. A package of desired reports with flow charts and data requirements was assembled to facilitate discussions with software technicians. In October 1981 it was decided to use the timeshare system of the Control Data Corporation. Its services were already being used by MTDB's financial management staff.

A member of the MTDB planning staff, working closely with the Control Data technical representative, directed the creation of 20 report specifications using Control Data's X/L data base management system. (Report specifications were also developed for use in TDA claim analysis and the annual update of the 5-year operating and capital projects program, the Transportation Improvement Program. These other uses will not be discussed in this paper.) The

MTDB staff person attended one initial orientation seminar provided by Control Data and gained additional knowledge of X/L while developing the software. Data base and report specification development was essentially complete in February 1982. Ongoing technical assistance is provided by Control Data.

A documentation manual that details the report specifications and data files was compiled by MTDB. The manual includes step-by-step instructions for accessing the system as well as notes on the use of each report specification. Included in the appendixes are listings of all report specifications, the structure and contents of each data file, and a collection of sample reports.

COST OF IMPLEMENTATION

The cost of creating the report specifications and data files was approximately $20,000, including timeshare expense and staff time. (This figure includes several other report specifications, details of which are not included in this paper.) Because the monitoring activities were not performed to a similar degree before using the computer, accurate before-and-after cost comparisons are not possible. The timeshare cost of producing the monthly reports is around $5.00 when all available cost reduction techniques are used. These techniques include processing overnight and using report specifications that have been pretranslated into the system's operating language. Monthly charges, which are based on the amount of connect time, data storage, and processing units, range from $300 to $2,500. Costs can be minimized by processing pretranslated specifications overnight whenever possible and regularly purging unneeded files.

OPERATOR-MONITORING REPORTS

Operator performance is monitored both monthly and quarterly. Four reports have been developed using the following statistics from existing operator reports:

- Total operating cost,
- Fare revenue,
- Revenue passengers,
- Total passengers, and
- Revenue-miles.

Examples of two of the reports, M1 and M4, are included in this paper. Four data files have been established for these reports (Table 1). One of the files, TDAMONT PERFDATA, is structured to contain 1 year of monthly data by operator and is updated monthly. The other three files, TDAMONT JURISDICTION, TDAMONT OPERATOR, and TDAMONT RATES, are updated with new information at the beginning of the fiscal year and as needed during the year.

Operator Report

The Operator Report, Report M1, (Figure 1) shows the TDA spending rate of each operator. From year-to-date information on operating cost, fare revenue, and federal assistance (UMTA Section 9, San Diego Transit only), the amount of TDA money expended is calculated using the following equation:

$$TDA = Operating\ cost - (Fare\ revenue + Section\ 9)$$

The amount of TDA money expended is then annualized using the following straight-line equation:

$$TDA\ (Annual) = TDA\ (Year\ to\ date)/Number\ of\ months$$
$$\times\ 12$$

The forecast annual TDA figure is compared with the amount of TDA money available and the resulting surplus or deficit is reported.

Jurisdictional Analysis

The Jurisdictional Analysis, Report M2, reports the financial status of each jurisdiction. An operator's surplus or deficit is apportioned to each of its contracting jurisdictions on a proportional basis. The annual amount of TDA assistance needed is forecast, again using the straight-line method, and compared to the jurisdiction's contract amount. The

TABLE 1 Data Files for Operator Monitoring Reports

File	Report	Contents
TDAMONT JURISDICTION	M2, Q2	Jurisdiction code Jurisdiction name TDA available
TDAMONT OPERATOR	M1, M2, M4 Q1, Q2, Q4	Operator code Operator name Section 5 (federal aid) available TDA available Current and previous year annual 　Operating cost 　Revenue-miles 　Revenue passengers 　Total passengers 　Operating cost/revenue-mile 　Revenue passengers/revenue-mile 　Total passengers/revenue-miles
TDAMONT PERFDATA	M1, M2, M3, M4 Q1, Q2, Q3, Q4	Operator code Current year monthly 　Operating cost 　Fare revenue 　Revenue passengers 　Total passengers 　Revenue-miles
TDAMONT RATES	M2, Q2	Jurisdiction code Operator code Proportion of operator's total TDA 　from jurisdiction Contract TDA amount

SAN DIEGO METROPOLITAN TRANSIT DEVELOPMENT BOARD
TDA OPERATIONS MONITORING

OPERATOR REPORT
NOVEMBER -- FY 84

PREPARED: 1/23/84

REPORT: M1

| OPERATOR | OPERATING COST | | FARE REVENUE | | TDA EXPENDED | | FORECASTS | | TDA ANALYSIS | |
	MONTH	YTD	MONTH	YTD	MONTH	YTD	ANNUAL OPERATING COST	ANNUAL TDA SUBSIDY	AVAILABLE BY CONTRACT	ANNUAL SURPLUS/ (DEFICIT)
CTS SUBURBAN	$122,845	$632,723	$22,677	$103,366	$100,168	$529,357	$1,518,535	$1,270,457	$1,451,985	$181,528
CTS EXPRESS	$19,670	$104,126	$9,614	$46,224	$10,056	$57,902	$249,902	$138,965	$156,410	$17,445
NCT	$53,190	$256,577	$14,824	$71,628	$38,366	$184,949	$615,785	$443,878	$499,700	$55,822
SDT	$2,666,359	$13,723,527	$1,041,256	$5,278,082	$980,226	$5,221,058	$32,936,465	$12,530,539	$12,777,126	$246,587
STRAND EXP	$84,294	$431,157	$31,891	$173,570	$52,403	$257,587	$1,034,777	$618,209	$514,749	($103,460)
SD TROLLEY	$421,059	$2,019,935	$307,966	$1,566,578	$113,093	$453,357	$4,847,844	$1,088,057	$804,910	($283,147)
EL CAJON DAR	$33,384	$176,396	$9,938	$52,610	$23,446	$123,786	$423,350	$297,086	$369,620	$72,534
LA MESA DAR	$31,555	$162,277	$10,503	$52,027	$21,052	$110,250	$389,465	$264,600	$316,510	$51,910
LEM GROV DAR	$5,509	$28,589	$2,165	$10,766	$3,344	$17,823	$68,614	$42,775	$50,000	$7,225
CTS WHEELS	$27,887	$147,583	$3,802	$18,890	$24,085	$128,623	$354,199	$308,863	$313,200	$4,337
NAT CITY DAR	$2,989	$12,005	$401	$1,631	$2,588	$10,374	$28,812	$24,898	$34,001	$9,103

FIGURE 1 Report M1.

report also compares the total forecast TDA requirement to the amount of funds available.

Fare-Box Recovery and Operator Performance Indicators

The other two monthly reports, Farebox Recovery Report, Report M3, and Operator Performance Indicators, Report M4, (Figure 2) show monthly and year-to-date performance indicators with appropriate base statistics. The performance indicators included are the revenue-to-cost ratio, operating cost per revenue-mile, revenue passengers per revenue-mile, and total passengers per revenue-mile.

HOW THE REPORTS ARE USED

Administrative Uses

Reports M1 and M2 both reveal emerging trends in TDA expenditures. When a deficit appears for an operator or a jurisdiction, MTDB staff investigates the situation to determine if corrective action is appropriate. In some cases additional funds (TDA or other) may be available. In other cases changes in the operator's expenses, fare structure, or service level may be necessary. The primary utility of the M1 and M2 reports is the early recognition of possible funding problems in order to avoid crisis situations.

SAN DIEGO METROPOLITAN TRANSIT DEVELOPMENT BOARD
TDA OPERATIONS MONITORING

OPERATOR PERFORMANCE INDICATORS
NOVEMBER -- FY 84

PREPARED: 1/23/84

REPORT: M4

PERFORMANCE INDICATORS

| OPERATOR | OPERATING COST/ REVENUE MILE | | | | REVENUE PASSENGERS/ REVENUE MILE | | | | TOTAL PASSENGERS/ REVENUE MILE | | | |
	MONTH	YTD	FY 84 BUDGET	FY 83 ACTUAL	MONTH	YTD	FY 84 BUDGET	FY 83 ACTUAL	MONTH	YTD	FY 84 BUDGET	FY 83 ACTUAL
CTS SUBURBAN	$1.86	$1.87	$2.00	$2.00	0.63	0.60	0.51	0.57	0.80	0.76	0.65	0.73
CTS EXPRESS	$2.47	$2.59	$2.77	$3.26	0.71	0.69	0.70	0.75	0.71	0.69	0.71	0.75
NCT	$2.43	$2.28	$2.36	$2.36	1.26	1.20	1.07	1.10	1.90	1.83	1.59	1.64
SDT	$3.41	$3.42	$3.50	$3.40	1.97	1.98	1.95	1.94	2.41	2.42	2.37	2.37
STRAND EXP	$2.48	$2.56	$2.51	$2.43	1.44	1.52	1.69	1.52	1.84	1.94	2.04	1.94
SD TROLLEY	$3.21	$2.95	$2.89	$3.09	2.92	3.02	2.68	3.19	3.05	3.11	3.15	3.27
EL CAJON DAR	$1.37	$1.37	$1.45	$1.35	0.54	0.54	0.51	0.53	0.54	0.54	0.51	0.53
LA MESA DAR	$1.49	$1.49	$1.48	$1.37	0.50	0.49	0.44	0.43	0.57	0.56	0.52	0.49
LEM GROV DAR	$1.39	$1.38	$1.35	$1.38	0.72	0.68	0.67	0.67	0.74	0.70	0.67	0.68
CTS WHEELS	$1.38	$1.46	$1.52	$1.26	0.15	0.15	0.15	0.14	0.15	0.15	0.16	0.14
NAT CITY DAR	$3.07	$3.38	$4.84	$2.09	0.41	0.46	0.48	0.19	0.41	0.46	0.48	0.20

FIGURE 2 Report M4.

Reports M3 and M4 allow tracking of operator performance in terms of productivity. The Farebox Recovery Report, Report M3, allows MTDB to verify that the required revenue-to-cost ratio is being maintained. Operator Performance Indicators, Report M4, facilitate the identification of performance trends by reporting current year budget and previous year actual figures as well as monthly and year-to-date statistics. Data from all four reports are included in the Quarterly Operations Report prepared for the MTD Board of Directors.

Planning and Operations Uses

The performance indicators developed in the reports assist MTDB to recognize the trends of individual operators and of the region as a whole. For example, passenger productivity, as measured by passengers per revenue-mile, has declined during the last 2 years. This situation has prompted MTDB and the operators to explore means of increasing ridership. Two of the options being considered are expanded marketing efforts and alterations to the fare structure.

In an effort to make marketing activities more effective, an extensive market survey is being developed to identify market segments with potential for increased transit ridership. When these specific market segments have been identified, marketing efforts will be tailored to those groups. Efforts are also under way to develop a fare structure that bases fares more closely to distance traveled in hopes of luring back short trip makers lost to the system as the result of previous fare increases.

In some cases service changes can improve an operator's productivity. A good example involves the San Diego Trolley. Two small operators, National City Transit and South Coast Organization Operating Transit, had generally substandard passenger productivity before the opening of the San Diego Trolley. When the Trolley started operations and the routes of these small operators were restructured to provide feeder service, the interconnection of these two operators with the Trolley helped to raise the number of passengers per mile and the fare-box recovery significantly.

Future Uses

The establishment of these reports and the accompanying data base affords an opportunity for various uses in the future. The most likely addition will be the development of a quarterly summary report in a format suitable for direct submittal to the MTD Board of Directors. Such a report would streamline the process of selecting specific statistics from the current reports for inclusion in a separately written report to the board.

A significant development planned for implementation within a year is the use of computer graphics capability. MTDB has purchased a minicomputer with a microcomputer included in the package and MTDB staff

have begun a search for suitable microcomputer software. It is expected that concurrent with the software purchase, an eight-pen plotter will be purchased to produce report- and presentation-quality graphics. There is the possibility that the graphic equipment could be underused initially. However, the expected flexibility of the software, coupled with an increased emphasis on high-quality graphics, should ensure efficient use of the capability by several staff members.

The existence of the data base facilitates the efficient retrieval of information for ad hoc purposes. The X/L data base management system provides the capability of manipulating data for specific needs in the data file itself, eliminating the need to write a special report specification. For example, if the fare-box recovery of a specific group of operators is needed, a staff member can retrieve the necessary data, specify the calculation to be performed, and print the results, all within the data file itself. The data files have already been used in this way and it is likely that this kind of use will increase.

Another use of the data base may be forthcoming as part of an effort to consolidate data collection from the region's operators. Both the San Diego Association of Governments (SANDAG) and MTDB currently collect information from transit operators for different purposes. A recently completed performance audit of the two organizations recommended consolidation and reorganization of data reporting. In response to this directive, MTDB and SANDAG are working to streamline and consolidate the collection of data. With any needed alterations, MTDB's data base may serve as the basis for storing and manipulating data received under a revised format.

CONCLUSION

The operator-monitoring system has been advantageous to MTDB because it has

• Increased the availability and dissemination of data,
• Facilitated regular detailed performance analysis,
• Increased the accuracy of performance analysis,
• Reduced staff time previously spent on performance and financial analyses,
• Enhanced the ability of MTDB to foresee financial problems and identify performance trends, and
• Established a data base that can be used for ad hoc research needs.

MTDB has developed its operator-monitoring (and other) computer applications without an in-house programmer or operator. Staff people in charge of particular activities have the responsibility for developing and maintaining the report specifications and data bases. As a result, several staff members have learned computer skills, thus enhancing the opportunity for increased use of computer capability in MTDB's activities.