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Automated Repair Service Bureau:

The Trouble Report Evaluation and Analysis Tool

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The Trouble Report Evaluation and Analysis Tool (TREAT) is a system that provides Repair Service Bureau (RSB) personnel with an effective analysis tool for trouble reports that have been repaired (closed). TREAT consists of a set of computer-produced reports that can be tailored to the user's needs through the use of a simple report generator language. The user is supplied with approximately 50 reports written in the report generator language and can build new ones or change copies of the standard ones. With the aid of a large collection of written documentation and the methodology supplied with the software, users can investigate certain problem areas and determine possible solutions.

I. INTRODUCTION

The Trouble Report Evaluation and Analysis Tool (TREAT) is a system that provides Repair Service Bureau (RSB) personnel with an effective analysis tool for closed trouble reports. TREAT consists of a series of computer-generated reports. The user is able to obtain reports either in a standard format or in a high-level report language. The user's guide (*Bell System Practices*) is extensive and contains both report documentation and methodology. Through proper use of the guide and the reports, certain problem areas may be detected and corrected.

II. OVERVIEW OF TREAT FEATURES

The objectives of this paper are to provide the reader with an overview of TREAT's features and a description of its development. The

remaining sections of this paper describe analyses of TREAT's output, give more details on its usage, and cover its developmental history and future use.

With the use of TREAT, some of the primary areas of investigation are the following:

(*i*) Common equipment troubles, e.g., disproportionally large number of trouble reports on one switching machine.

(*ii*) Not-found troubles (trouble reports where the line either tested okay or was found in the field to be okay), e.g., transient transmission noise problems.

(*iii*) Customer service problems, e.g., an abnormally large rate of missed appointments.

(*iv*) Repair personnel productivity and performance, e.g., exceptionally long average repair time for outside craft.

The TREAT reports are generated from a data base of closed trouble reports that are submitted to TREAT daily from the Loop Maintenance Operations System (LMOS) or from a Bell Operating Company (BOC) manual trouble report collection system. Typical RSBs process 100 to 500 trouble reports a day.

The TREAT analysis strategy is to use automatically generated reports to detect a problem area, then isolate the source of the problem through use of the requestable reports. These reports may be either prestructured or user defined. For this to be effective, the requestable reports must be easily and quickly obtainable. This was one of the basic design goals of TREAT.

The automatic reports are set up for each RSB and sent at a predetermined frequency—usually daily, weekly, or monthly. Most daily reports employ a threshold mechanism whereby certain lines are printed only if the value exceeds the preset threshold. These reports are transmitted to the RSB by using LMOS printers or teletypewriter terminals.

The requestable reports are sent to the RSB or to a staff analyst only when requested. There are about 50 standard reports that may be requested by entering the report number and a few other parameters. Others may be constructed entirely by the requester through a high-level report generation language. The turnaround time to obtain the output can vary from a few minutes to a few hours, depending on performance options specified by the local companies.

The TREAT reports are simple in format, being either the tabular or list type. The tabular type provides a matrix of counts that satisfies the selected criteria (Fig. 1). The list type provides selected fields from the trouble reports that satisfy the selected criteria (Fig. 2). The tabular type aids in global problem identification, whereas the list type permits investigation on a more detailed level.

TREAT REPORT NUMBER 11

CABLE COUNT ANALYSIS

WILMINGTON RSB029 PERIOD 10-02-74 TO 10-08-74

THRESHOLD =03

WFR	CA	PR	TROUBLE REPORTS
654	003	00	4
654	013	05	5
654	017	09	5
654	028	13	6
654	040	06	7
654	040	08	4
654	043	02	16
654	420	11	5
654	999	99	136
762	004	05	6
762	223	07	5
792	012	07	6

Fig. 1—Cable count analysis—tabular version.

TREAT REPORT NUMBER 12

CABLE COUNT ANALYSIS

LOCUST RSB002 PERIOD 09-10-74 TO 10-08-74

WFR	CA	PRNO	TN	DATE RECD	TIME RECD	T	DISP
110	234	02	215-5617364	100474	1632	3	0700
110	234	11	215-5615879	100274	2200	2	0900
110	243	11	215-5687731	100374	1540	1	0700
110	243	11	215-6658989	093074	1626	4	0700
110	248	12	215-5612520	100374	1540	1	0700
110	248	12	215-5688059	100973	1003	3	0700

Fig. 2—Cable count analysis—list version.

III. ANALYSIS

The bureau's trouble reports provide information useful in detecting areas for improvement. Some of the data items in the trouble report stored for analysis by TREAT are as follows:

(*i*) Telephone number

(*ii*) Data and time reported, tested, dispatched, and cleared

(*iii*) Category of report (customer direct, customer relayed, or employee report, etc.)

(*iv*) Class of service (business, residence, PBX, coin, etc.)

(*v*) Type of report—what the customer told the repair service attendant, e.g., no dial tone

(*vi*) Disposition—what was done to fix the trouble, e.g., repaired station set

(*vii*) Cause—what caused the trouble, e.g., weather

(*viii*) Central office line equipment

(*ix*) Cable and pair

(*x*) Repair personnel, e.g., RSB tester or outside craft

(*xi*) Elapsed time for each step in the repair process

(*xii*) Miscellaneous other items.

This ability to specify trouble report selection criteria allows the requester to narrow the scope of the problem and to reduce the amount of printout obtained. This is a crucial feature because the RSB users may not have high-speed printers.

As an example of TREAT usage, one of the morning reports (Fig. 3) summarizes the trouble report activity of the previous day and accumulates the activity for the report month. The report month runs from the 23rd of one calendar month to the 22nd of the next. In the example provided, the threshold for item R is exceeded. This indicates that repeated reports (i.e., troubles where the customer calls back within 30 days) are still too high. TREAT report number 17 (Fig. 4) shows, by tester, how many tested reports later had another "repeated" report. This example shows that tester "1" had about 16 percent (92/593) repeated reports, higher than the user's objective of 10 percent. A detailed listing of all of these reports can be requested and reviewed for possible improvements in the testing procedure or additional tester training.

In addition to the analysis-oriented reports, TREAT provides a series of reports and interfaces for AT&T, public utility commissions, and other centrally developed systems.

IV. USAGE

TREAT executes on an IBM 370 compatible computer. The requestable reports are obtained through IMS requests that feed a batch reporting system (Fig. 5). The automatic reports come from a strictly batch system. The IBM 370 was chosen because it was the same machine supporting LMOS. This choice also made it possible to deploy TREAT in advance of LMOS since all BOCs had data centers with 370 capability.

TREAT REPORT #1, PART 4 E2700 ITEM THRESHOLDS EXCEEDED

PSC WILMINGTON 9100 PERIOD 09-23-74 THRU 09-26-74

ITEM	THRESHOLD LEVEL	ACTUAL LEVEL
CC-OTH	.7	.9
TRAN & NOISE	.7	.8
CBC	1.0	1.1
MISC	.8	1.0
OTH STA EQ	.6	.7
FOK OUT	.4	.6
REF OUT	.2	.3
PLT OR EQ	2.5	3.0
DATA SW	1.0	25.0
BUS	7.0	9.5
PBX	4.0	6.3
COIN PUB	25.0	46.1
SS TLG	7.0	9.4
SS TEL	2.0	3.0
MISS APT	3.0	3.7
WRK COM	3.0	3.8
R	10.0	13.3
NO ACCESS	4.0	4.8
REC BF 5	87.0	89.0
CO-RAF5	60.0	62.4
CUS DISPTH	50.0	54.0
RAC	4.0	5.0
EXCLUDE	3.0	3.6

Fig. 3—Morning report.

The TREAT data base consists of closed trouble reports for the most recent 40 days. The 40-day period was selected to provide a monthly data base, with enough extra days to be certain that end-of-the-month reports can be generated before first-of-the-month data are deleted. The trouble reports are entered into TREAT nightly from either LMOS or from a BOC-supplied collection system. This is a batch operation in which trouble reports are edited and either accepted or rejected, certain fields are automatically scored, and data are entered into the data base. The 41st day's data are removed with each update. The data are organized by RSB, with the oldest data at the end of the files.

All TREAT reports are generated either from this 40-day data base, known as the Cumulative Abbreviated Trouble (CAT) file or from summary files derived from the CAT file. Daily reports are generated after the update is made.

In addition to the CAT file, there are several auxiliary files used to define RSB hierarchy up to the company level (six levels), and other RSB parameters used to run TREAT. These files are updated rather infrequently as needed.

The heart of the report-generating capability of TREAT is the report

TREAT REPORT NUMBER 17

REPEATED REPORT ANALYSIS CRAFTSPERSON - TESTER OR VERIFIER

LOCUST RSB002 PERIOD 09-10-74 TO 10-08-74

TESTER OR VERIFIER	ORIG REPEATER	TOTAL TESTS
--	24	105
A	1	7
D	0	1
H	0	2
J	0	3
M	0	1
P	0	1
Q	1	12
R	3	13
O	14	71
1	92	593
5	45	345
8	33	342

Fig. 4—Repeated report analysis for the craft person.

compiler. This report compiler is used to generate most of the reports. The report compiler can generate both tabular- and list-type reports. The command language was designed to be easy to use at the expense of extremely complex reports. For example:

TITLE	Starts the report and gives a report title.
RSB(rsb#)	Selects the RSB for the report.
DAY(day1,day2)	Selects the span of days to be included in the report.
CONDITION(expr)	Gives the trouble report selection criteria. Simple Boolean expressions are allowed, but not arithmetic expressions.
SORT	Sorts by fields on the trouble report.
PRINT	Gives the fields to print on a list-type report,

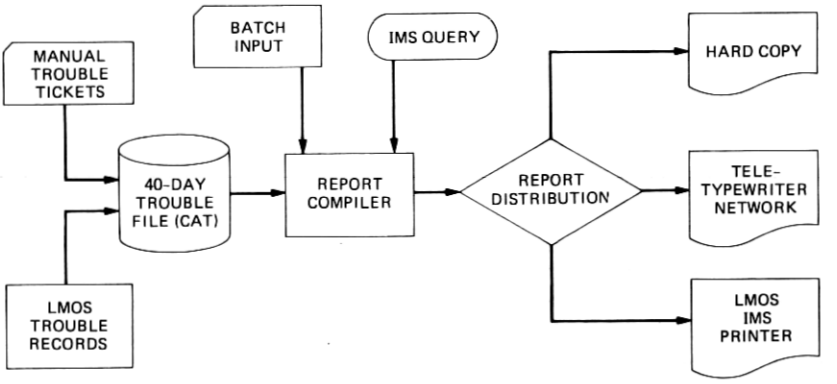

Fig. 5—TREAT report generation.

or the horizontal and vertical fields to use for a tabular report.

A sample list-type report is as follows:

```
TITLE (This is a sample TREAT report request)

RSB(020)

DAY(1,10)

CONDITION(CAT=1&CS=04)

SORT(RECD,TN)

PRINT(RECD,TN,TYPE,DISP,CAUSE)
```

Although there are currently about 25 commands, most reports can be obtained with six to eight commands. In actual practice, the commands used are fairly simple.

The automatic reports are run off-hours through the report compiler as batch programs. The output is usually placed on a file to be transmitted back to the user at the RSB rather than printed at the data center.

Other than an older Time Sharing Option (TSO) of TREAT, there are two report request modes:

(*i*) *ONLINE*—The report request is entered by requesting an Information Management System (IMS) report request mask at an LMOS on-line terminal. The mask is filled in with TREAT commands as

illustrated above and transmitted. The request is queued up and the actual report is prepared in a deferred batch mode, along with those from other requesters. Depending on the company's choice, this is done from a few times a day to several dozen times a day. The output is returned to the RSB on an LMOS on-line printer. Turnaround in this mode varies from 10–15 minutes to a few hours depending on the BOC's environment.

(*ii*) *BATCH*—The report requests are gathered manually, and the inputs are prepared in punched-card format. The reports are generated in a batch mode, with the printout usually being delivered to the requester by mail. Fortunately, this is not a mode that is used very much, but was useful prior to converting to LMOS.

The report compiler runs the same way in all modes, which makes for an easy user transition from batch to on-line because the reports are identical—only the method of requesting changes.

TREAT has about 50 standard reports that were designed to provide a BOC with a basic set of reports. About 40 of these reports are generated by the report compiler, and are delivered as source commands. An analysis plan is also furnished to the users as a guide to help them in determining the order of report analysis and to aid them in ascertaining the actual problem. This approach allows BOC personnel to make local changes to standard reports and also learn how to set up additional reports. Most BOCs have set up many additional standard reports. In the BOCs today, the majority of the reports are requested directly with the report compiler language rather than with the standard prestructured reports.

V. HISTORY

TREAT had its beginning in January, 1973, as the reports portion of the MLR (Mechanized Line Record system) trial at New York Telephone Company. It was designed to provide some of the standard required reports for the RSB. Fortunately, it was early recognized that several reports were similar in format and could be produced by a simple general-purpose report compiler. These reports were the list type, and the first report compiler only had about eight commands (it now has over 25). TREAT, in this MLR environment, was well-accepted by RSB personnel, who especially liked getting reports the next day. There were no requestable reports as such, but the number of "standard" automatic reports grew rapidly. This system eventually grew to support the 12 RSBs on the MLR system.

In 1974, AT&T began looking for a replacement for its Mechanized Customer Trouble Report Analysis Program (MCTRAP), which was over ten years old, and was becoming difficult to change. There were three choices:

(*i*) Build a new MCTRAP II by using specifications prepared by Bell Laboratories from a Chesapeake & Potomac Telephone Company study.

(*ii*) Expand the programs used for the MCTRAP II study to a working production system.

(*iii*) Separate TREAT (not called TREAT at the time but, rather, the MLR off-line system) from MLR, and offer it as a stand-alone system.

TREAT was chosen because it was the only one in a production mode, it already had a working report compiler, and it was supported by a Bell Laboratories development staff committed to LMOS/TREAT for years to come. The MLR department head, R. L. Martin, completed the decision-making process by coining the acronym "TREAT."

AT&T chose The Bell Telephone Company of Pennsylvania (PA) as the trial company, and a trial start date of June 23, 1974 was set. It was decided to offer requestable reports through TSO and to design a new set of standard reports. A task force met at PA and designed the first set of standard reports. Interestingly enough, these reports have remained virtually unchanged to this date. The major work needed in TREAT for the trial was to provide a manual trouble report interface, implement the 40 standard reports, add the tabular report feature to the report compiler, and provide a TSO report requesting interface.

TREAT, operating out of a Bell Laboratories data center, was put on-line for four trial RSBs in June, 1974. It was run for four months in this fashion, then it was moved to PA's data center. During this period, most work centered on cleaning up and changing the standard requestable reports. In addition, the TREAT User's Guide was developed by PA.

TREAT was then installed in the Houston area of Southwestern Bell Telephone Company (SW) to precede the LMOS installation. Although TREAT was to be run in batch mode only at SW the real test was that it would have to support 65 RSBs, a much larger number than before. This installation was completed in November 1974, and the worst fears were realized. Some of the TREAT update jobs had run times that appeared to increase with the square of the number of RSBs. Jobs that took minutes at PA and New York Telephone Company (NY) ran for almost two hours at SW. Otherwise the system worked well.

The first release of TREAT to Western Electric Company (Issue 1) was in February, 1975, with some of the performance problems corrected. Issue 1 was installed at South Central Bell Telephone Company (SO CN) and expanded to 135 RSBs (still the largest TREAT installation). South Central Bell Telephone Company personnel commented that "some part of TREAT was running 24 hours a day." Issue 2 was installed at SW (which had now become a trial company) in May, 1975, with still more performance improvements.

A redesign of TREAT was undertaken with an objective of significantly reducing the run times. One way this was accomplished was through a more optimized file structure. This was to be TREAT, Issue 3, nicknamed "speedy TREAT." "Speedy TREAT" was first installed at NY to replace the MLR version in December, 1976. First measurements were very encouraging. Tests were then run at SW in January, 1977, and the results were outstanding. "Speedy TREAT" met all expected performance objectives, and some that had not been planned. South Central Bell Telephone Company, which was limping along with TREAT Issue 2, quickly converted to "Speedy TREAT" in February, 1977, and promptly announced that they were so pleased with TREAT that they had no more requests for changes.

Deployment of TREAT then began in earnest, and companies cut at a rate of one per month through 1977 and 1978. At this writing, all BOCs are using TREAT and there are 32 data centers involved, making TREAT the most widely deployed centrally developed system.

As an indicator of the acceptance of TREAT, over 6000 TREAT User's Guides have been sold.

Finally, Issue 4 of TREAT was developed to change one of the major reports to reflect the business/residence/coin split of the Bell System, and to provide a few new features; New Jersey Bell Telephone Company tested it in the summer of 1978.

VI. TREAT'S FUTURE

As a part of the second major version of the Automated Repair Service Bureau (ARSB-2), the architecture and the implementation of TREAT were reexamined by Bell Laboratories. Two significant areas were explored.

The first area was the user and the data system oriented requirement—both current and future. A particular area of concern here was the degree to which Issue 4 served the needs of a vastly restructured corporation.

The second area involved the internal implementation. The software was getting old and had been patched frequently. The global system design, on the other hand, was still judged to be sound.

After the investigation of several alternatives, it was determined that a two-pronged approach was appropriate. The code is being redesigned and improved using newer software technologies. At the same time, we are incorporating several enhancements to the system to respond to the changing corporate requirements. As an example of these changes, all of the reports and the data bases in the next issue will be segmented. This will permit the user to retrieve all these reports collected by business, residence, public services, or network. This can

be done either on an individual bureau basis or on any level in the management hierarchy.

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