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A Socio-Economic Impact Assessment of the Computerized Customer Information System (CCIS) at the Southern California Rapid Transit District (SCRTD)

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June 1983
Final Report

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SOCIO-ECONOMIC IMPACT ASSESSMENT OF THE COMPUTERIZED CUSTOMER INFORMATION SYSTEM (CCIS) AT THE SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT (SCRTD)

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This document is a product of an ongoing program to assess the impacts of tomated transit information system (SIIS) technology on the transit dustry's efforts to improve the productivity and quality of telephone formation/marketing services to the public. The report presents scriptions of a variety of data collection and analysis efforts dertaken in the evaluation of the Computerized Customer Information stem (CCIS), an automated transit information system currently being plemented and tested in a pilot deployment at the Southern California pid Transit District (SCRTD). The objective of this report is to antify and assess the impacts of this application of ATIS technology on stem users and management within the SCRTD, as well as on the general blic in the Los Angeles area being served by the system, and to determine w well the CCIS met its pre-implementation objectives. It is hoped that e descriptions of system implementation efforts in this report will also rve to provide helpful insights for other transit systems interested in e application of ATIS technology. The key elements in this assessment re measures of information system demand, information agent productivity, stem response accuracy, agent job satisfaction, and economic benefits to e SCRTD from system implementation. Other variables were benefits of ntralized data base updating and potential uses of the system as a source by other SCRTD departments. The authors conclude that the CCIS lot demonstration has achieved most of its intended objectives and is rrently functioning with the support and confidence of its users.

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The intent of the project was to produce a consistent and inter-related group of symbols to bridge the language barrier and simplify basic messages at domestic and international travel facilities. The working process attempted to take full advantage of strong and widely recognized existing symbol concepts and to introduce new symbol forms only where no satisfactory concepts existed. The report includes detailed descriptions of the process employed to create the symbols as well as guidelines for their use.

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16. Abstract

This report documents a series of data collection efforts carried out by Wilson Hill Associates, Inc., in support of UMTA's Impact Assessment Program. The focus of these efforts was the Automated Transit Information System (ATIS) deployment in the Customer Information Section of the Marketing Department at the Southern California Rapid Transit District (SCRTD) in Los Angeles. This system, known as the Computerized Customer Information System (CCIS), was implemented with UMTA funding in the interest of making the SCRTD's public telephone information services more efficient. This efficiency is accomplished through automation of data retrieval functions traditionally performed manually by trained telephone information operators or agents. Key parameters in this assessment were measures of information system demand, information agent productivity, system response accuracy, agent job satisfaction and economic benefits to the SCRTD from system implementation. Other variables of interest were the benefits of centralized data base updating and potential uses of the system as a resource by other SCRTD departments.

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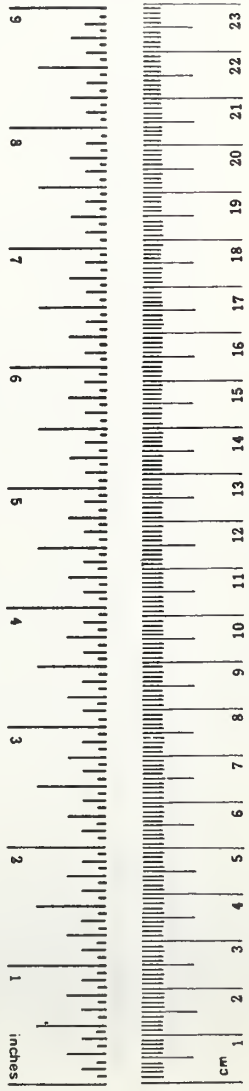
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

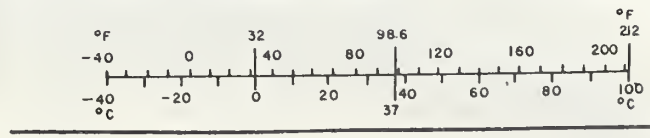
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	squere inches	6.5	square centimeters	cm^2
ft^2	squere feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	squere kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teespoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures. Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	squere centimeters	0.16	square inches	in^2
m^2	squere meters	1.2	square yerds	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius tempereture	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

This report has been prepared by Wilson Hill Associates, Inc. for the Transportation Systems Center's (TSC) Service Assessment Division in support of the Impact Assessment Program conducted by the Urban Mass Transportation Administration (UMTA) Office of Technical Assistance, Analysis Division. UMTA is cooperating with and supporting the transit industry's efforts to improve the productivity and quality of telephone/information marketing services to the public. The principal focus of this support is on the implementation of Automated Transit Information Systems (ATIS) technology. TSC, in support of UMTA's program, is evaluating ATIS demonstrations in Los Angeles and Washington DC. This report is an interim product in an ongoing ATIS impact assessment program.

While specifically intended for the information of TSC and the management staff of the Southern California Rapid Transit District, this report is also generally directed at the transit public information/marketing community and others interested in the application of computer-aided information retrieval systems.

The evaluations described in this report were conducted under the management of Mr. Robert Furniss and Mr. Robert Phillips, Project Managers for Wilson Hill Associates. Mr. Furniss was Project Manager through February, 1981 when he resigned his position at Wilson Hill to accept employment elsewhere. On this date, Mr. Phillips assumed project management responsibilities. Subsequently, Mr. Furniss was hired through a subcontracting agreement with Wilson Hill to provide additional services relating to the project, namely post-implementation interviews of SCRTD management staff.

Much gratitude is expressed by the authors to those SCRTD personnel involved in telephone information services, especially Ms. Paddie Brennen, Mr. Doug Anderson, Mr. Bob Williams, Ms. Barbara Hagen, and Ms. Rose Marie Candejas. Thanks also go to Ms. Suzanne Diller and other employees of the system design contractor for their cooperation throughout the project. In addition, special thanks go to Mr. John Durham of UMTA, Mr. Michael Wolfe and Dr. Arthur Priver, TSC contract monitors, for their encouragement and managerial support.

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EXECUTIVE SUMMARY

This report is an interim product in an ongoing program to assess the impacts of Automated Transit Information System (ATIS) technology on the transit industry's efforts to improve the productivity and quality of telephone information/marketing services to the public. It was prepared by Wilson Hill Associates, Inc. for the Transportation Systems Center's (TSC) Service Assessment Division in support of the Urban Mass Transportation Administration's (UMTA) Impact Assessment Program. The TSC, as part of this UMTA program, is evaluating ATIS demonstrations currently underway in Los Angeles and Washington, DC.

This report documents a number of data collection and analysis efforts undertaken in the evaluation of the ATIS demonstration in Los Angeles at the Southern California Rapid Transit District. This ATIS, known as the Computerized Customer Information System (CCIS), is currently undergoing testing in a pilot implementation covering the San Fernando Valley, a portion of the SCRTD service area. While specifically intended for the information of UMTA/TSC and the management staff of the Southern California Rapid Transit District, this report is also generally directed at the transit public information/marketing community and others interested in the application of computer-aided information retrieval systems.

A telephone information service is one tool frequently employed by large transit authorities as part of their overall public marketing strategy. Telephone information has several distinct advantages as compared with printed advertising media:

- It is readily accessible to a substantial fraction of the transit-riding public;
- It can be frequently updated to reflect changes in schedules, routes, etc.;
- It can be personalized to meet the demands of the individual caller.

The Telephone Information Section of the Customer Relations Department at the SCRTD is one of the largest telephone transit marketing centers in the nation. Its 85 agents answer caller queries about transit service in 3 shifts, 24 hours a day, 365 days a year. On an average day, between 10,000 and 13,000 calls are received by the Section. During peak demand periods, agents answer over 800 calls per hour. Despite this effort over 30% of all incoming calls are "lost" in peak periods, that is callers put on hold by telephone answering equipment hang up before ever reaching an agent or receiving any information.

Telephone information agents at the SCRTD have traditionally retrieved information to answer caller queries by referencing large indexed volumes of schedules, headway sheets, route descriptions, etc. located at their work stations. Advances in computer technology over the past decade have enhanced the potential for automating these data retrieval functions. Certain aspects of these functions lend themselves well to computer applications:

- they are highly repetitive;
- they require a large amount of memorization of routes, schedules, geographic characteristics, etc.;
- they often involve optimization of a certain variable (for example, travel time);
- they should demonstrate a high degree of consistency; and
- they should be accomplished as quickly as possible.

Application of computer logic, memory, and speed to these functions thus raises the potential for improving the agent's job in a variety of ways. These improvements could also produce benefits not only for the agents, but also for the SCRTD management and the general public. Among these potential benefits are:

- Improved productivity in terms of agent calls per hour answered due to faster data retrieval;
- Increased reliability and consistency of agent responses;
- A reduction in training time for new agents;

- Improved capability to rapidly incorporate changes in transit agent reference data;
- Expanded capability to gather statistics concerning individual agent and Information Section performance;
- Use of the transit system data base by other SCRTD departments as a planning resource.

Computer-assisted data retrieval changes the information agent's job in a variety of ways. ATIS operation involves an agent retrieving desired information through use of a remote interactive computer terminal located at the agent's work station. The system is activated by the agent entering caller query data on the keyboard and selecting appropriate functions to produce the desired type of response. Following processing, which takes a matter of seconds, the computer outputs several appropriate responses. The agent then evaluates these responses in light of the query and selects the most appropriate one to provide to the caller.

The primary purposes of this evaluation were twofold: First, to determine the effects of these job changes on agent performance and job satisfaction; and second, to measure the extent to which the pilot San Fernando Valley area demonstration had produced the intended benefits of system implementation, stated above.

In this effort, a large amount of quantitative and qualitative data were collected. Quantitative data collected included statistics on Information Section performance gathered by the Automatic Call Distribution (ACD) system and on CCIS agent performance compiled in a daily CCIS log file over a 90-day steady-state evaluation period. Qualitative data were gathered through opinion surveys administered to the information agents before and after this evaluation period and through interviews with key SCRTD personnel involved in system implementation. Data of both types were also gathered in a controlled experiment in which nine information agents representing three different experience levels and three different modes of data retrieval (CCIS only, Manual only or a combination of both) were asked to respond to a standardized set of itinerary queries developed by SCRTD and the evaluation contractor.

A careful review of these quantitative and qualitative data leads to generally positive findings concerning the overall performance of the CCIS in its pilot demonstration. While the implementation process was rather extended and somewhat laborious due to a variety of internal and external problems, trends in the data collected show that most of those problems have been corrected and the system is for the most part, currently functioning as originally intended. System performance in achieving a number of different implementation objectives is discussed below:

Agent Productivity

Data collected during the course of the evaluation leads to rather conflicting conclusions concerning system influences on agent productivity. Under controlled experimental conditions, the more experienced CCIS agents were appreciably faster than were their manual and mixed mode counterparts. Similarly, projected call counts for CCIS agents on the CCIS log file averaged almost 30 per hour, a 50% increase over the SCRTD's manual standard of 20. Yet statistics collected for CCIS agents during the 90-day evaluation period show that they did not perform at this 30-per-hour figure, in which time spent between calls is rather unrealistically assumed to be zero; rather, their call counts were closer to the 20 per hour standard, largely a result of extended agent breaks between some calls. The CCIS agents' overall percentage of calls answered vs. calls lost is quite comparable to that of the manual agents; both groups answered an average of about 60% of total incoming calls. In addition, their self-admitted call counts on both the agent "before" and "after" opinion surveys averaged approximately 20 per hour.

One conclusion to be drawn from these conflicting data, developed through consultation with the CCIS Program Manager, is that the system can indeed enable experienced agents to approach the higher rate of 30 calls per hour. However, the mental stress experienced by an agent working at this pace is too great for it to be sustained for extended periods. Nevertheless, a prime advantage of the CCIS over manual retrieval is that all calls, even those involving the most complex itineraries, are of relatively uniform

length. CCIS agents are thus enabled, much more so than their manual counterparts, to develop a steady working pace. In the long run, the Program Manager stated, agent development of typing and call management skills will produce gradual increases in this steady pace. The implication is that the CCIS raises the potential, which as yet has not been achieved, for increases in overall Information Section productivity.

Response Accuracy and Consistency

The CCIS data base is extremely large and complex, and problems encountered in its creation (digitizing street addresses, for example) left it filled with numerous errors. Similarly, software routines developed for itinerary selection initially made certain over-optimistic assumptions concerning appropriate walking distances, transfer times, etc. Over an extended period, refinements and corrections developed in consultation with Information Section management and in response to agent "trouble reports" have gradually reduced the accuracy problem to nearly zero.

Agent responses to the "before" and "after" opinion surveys concerning system response accuracy show a decided shift towards acceptance of CCIS responses. In the "before" survey, only 40% of the agents felt CCIS accuracy was better than manual, while 60% felt that it was about the same or worse. In the "after" survey, 77% of the agents felt that CCIS accuracy was better, while only 23% felt that it was about the same or worse.

It cannot be overemphasized that the debugging and enhancement process was an interactive one in which agents and Information Section management were active participants. This interaction not only resulted in greater accuracy of the data base and a more workable system, but also led to increased confidence on the part of the agents that the system was being designed to meet their individual needs, and that they were contributing significantly to its accuracy. It is highly doubtful that this pilot demonstration would have enjoyed nearly the success that it has without the establishment of workable mechanisms to facilitate this interaction.

The CCIS Working Committee, Program Manager, and the "trouble report" system are all examples of such mechanisms. It is significant that the system designers, in retrospect, felt that they should have enrolled in the agent training course.

Agent Training

Interviews with Information Section management indicated that perhaps the greatest positive impacts exerted by the CCIS on the Section's operations would be in the area of agent training. By drastically reducing the need for agent memorization of geographical and route data, the standard agent training period can be cut at least in half. If trainees already possess typing skills, this period may be even shorter; the CCIS Program Manager cited the experience of training two Kelly Girl temporary employees to "reasonable" proficiency on the system in only one week.

This reduced training time has strong potential for benefits in the areas of improved personnel recruitment and retention. The work force from which agents are recruited can be greatly expanded to include older and part-time employees, neither of which was suited for the rigors of the agent training course used before. Statistics show that older employees are generally more dependable, and inclusion of part-time employees in the work force would allow management more flexibility than it presently enjoys in the scheduling of full-time agent vacations and other benefits. The long-term implication of these training benefits is significant cost savings.

Updating of Data Base

Another potential major improvement in Information Section operations brought about as a result of CCIS implementation is the capability to perform reference data base updating functions on a centralized basis. One full-time employee at a single terminal can perform the data base updating tasks presently performed almost full-time by 15 supervisors.

A side benefit of centralized data base updating mentioned by almost all of the Information Section management in their interviews would be an improvement in the job of supervisor. At present, supervisors spend practically all their time performing

update functions. As a result, their skill as agents tend to gradually diminish to the point where they are below those of less experienced agents. Centralized updating would free the supervisors to perform the functions for which their jobs were originally created: troubleshooting and solving system problems on the floor as they occur.

Agent Job Satisfaction

CCIS agent responses to the "before" and "after" surveys lend strong support to the hypothesis that implementation of the CCIS has led to an increase in agent job satisfaction. In the "before" survey, 67% of the agents rated their job satisfaction as excellent or good, while 33% rated it as fair or poor. In the "after" survey, 74% of the agents rated their job satisfaction excellent or good and 26% rated it as fair or poor. In the "before" survey, 52% of the agents described CCIS influence on their job satisfaction as "positive", 44% responded "no influence", and only 4% responded "negative". By contrast, in the "after" survey, 84% of the responses to the same question indicated "positive" influence, while only 16% indicated "no influence", and there were no "negative" responses. In addition, 75% of the manual agents responding to the "after" survey felt that learning to use CCIS would increase their job satisfaction, while 25% felt that it would decrease job satisfaction.

The implication of these results is that a sizable percentage of agents felt that CCIS influenced their job positively, and that this percentage showed an increasing trend over the course of the evaluation period. One agent summarized the CCIS on her job rather humorously; "I don't have to work any more; I can just talk all day."

Data Collection

The development of the CCIS log file as a data collection tool during the course of the system evaluation demonstrated clearly the ability of the system to keep accurate records on all aspects of system performance. Far more detailed data is now available to Information Section management concerning the performance of each CCIS agent and of the entire system than was

previously available with the less reliable ACD data. Furthermore, automated data collection would free the Senior Supervisor from a great deal of paperwork involving ACD counts, time sheets, etc., leaving more time to perform supervision work with the supervisors and agents on the floor.

Integration with Other Departments

Although a CCIS Working Committee has been established for the purpose of inter-departmental coordination of CCIS activities, the full benefits of a totally integrated data base incorporating stops, zones, routes, and schedules have yet to be fully realized at the SCRTD. This situation is the result of several factors:

- The CCIS is currently limited to the San Fernando Valley in its pilot demonstration;
- The Stops and Zones and Scheduling Departments currently use their own data processing systems which are incompatible with the Univac 1106 supporting the CCIS demonstration; and
- Management of other SCRTD departments appear at this point to have little detailed knowledge of the characteristics or potentials of the CCIS.

Should the proposal to expand the CCIS to cover the entire SCRTD service area be adopted by the Board of Directors, considerable attention should be given in system specifications to the creation of a fully integrated transit data base which would be of use to all SCRTD departments.

In conclusion, it is fair to say that the CCIS pilot demonstration has achieved most of its major intended objectives, and shows potential for the achievement of others. Despite early problems, it is currently functioning with the support and confidence of its users. Bringing about this result required dedicated hard work and a spirit of cooperation on the part of the SCRTD Management, the system designers, and the information agents. Without this work and cooperation, the system would never have achieved the success which it enjoys today.

1.0 INTRODUCTION

This report presents descriptions of a variety of data collection and analysis efforts undertaken in the evaluation of the Computerized Customer Information System (CCIS), an automated transit information system (ATIS) currently being implemented and tested in a pilot deployment at the Southern California Rapid Transit District (SCRTD). The objectives of this report are to quantify and assess the impacts of this application of ATIS technology on system users and management within the SCRTD, as well as on the general public in the Los Angeles area being served by the system, and to determine how well the CCIS met its pre-implementation objectives. It is hoped that the descriptions of system implementation efforts in this report will also serve to provide helpful insights for other transit properties interested in the potential application of ATIS technology to their own public information/marketing efforts.

1.1 AUTOMATION OF TRANSIT INFORMATION SYSTEMS

1.1.1 The Role of Telephone Information in Transit Marketing

Local transit properties have at their disposal a variety of media for marketing their services to the general public. Among these are printed schedules and maps, radio, television and newspaper advertising, and telephone information disseminated from a central office. As compared with other media, a telephone information service has several distinct advantages. First, it is readily accessible to a substantial fraction of the transit-riding public. Second, it is more reliable and up-to-date. Third, and most important, it can be personalized to suit the demands of the individual customer. For these reasons, particularly in urban areas having complex and perhaps multi-modal transit systems, a telephone information service is generally employed by local transit properties to overcome a major barrier to transit use: public apprehension of "getting lost" on public transit.

1.1.2 Traditional Transit Information Center Characteristics

In a typical transit system telephone information center, system employees (who in this report will be referred to as "agents") answer inquiries from prospective transit riders about schedules, routes, particular trip itineraries, fares, etc. Traditionally, the agent receives the caller's inquiry, usually assisting the caller in stating it as exactly as possible. Once the inquiry is understood, the agent consults route maps, schedules, headway sheets or other indexed printed information located at the agent's work station, piecing together the information desired. Once an appropriate response has been retrieved, it is provided to the caller.

Under this traditional manual system of data retrieval, the agent's command of interpersonal skills is particularly important. Of equal importance under this system is the agent's knowledge of both transit system and geographic characteristics. In order to be able to quickly locate a desired trip's original and destination and to effectively select appropriate transit routings between them, the agent must undergo intensive training as well as on-the-job skill development before full competency is achieved. This is especially true in cases where the transit system is complex and/or its service area is large.

1.1.3 The Potential for Automation of Agent Data Retrieval Functions

Advances in computer technology over the past decade have raised the potential for automating data retrieval functions performed by transit information agents. Certain aspects of these functions lend themselves well to computer applications. First, they are highly repetitive; a very large percentage of caller inquiries can be broken down into only four or five distinct call types, each requiring agent consultation of certain specific data. Thus, programming the computer for data retrieval is a relatively manageable task of duplicating agent

behavior elicited by each of the distinct call types. Second, data retrieval functions require a high degree of agent familiarity with service area geography and transit system characteristics. Characteristics such as these can be digitized on a coordinate grid system and mapped into the memory of a computer. Third, agent functions often involve optimization of response data to conform to limitations placed on certain trip parameters by the caller. For example, the caller might want to minimize total travel time, the number of transfers required, walking distances, etc. The logic underlying agent response selection in view of these caller stated limitations can be translated into comparing/optimizing computer routines in a very straightforward manner. Fourth, it is very important that agent data retrieval exhibit a high degree of consistency. While human error may introduce a certain amount of variability in agent responses, machine logic ensures that the same inquiry will elicit the same computer response every time. Finally, due to high public demand for their services, agents must work as quickly and efficiently as possible in retrieving data. The high-speed calculating capabilities of a computer are thus particularly appropriate in this application. Except for a relatively small percentage of cases in which agents are able to answer inquiries "off the top of their heads" automated data retrieval is faster than manual consultation of reference materials. For detailed inquiries involving multiple-transfer trips it is substantially (up to 100%) faster.

Thus, automation of data retrieval functions would appear to be a technically feasible means of improving a telephone information agent's capabilities in terms of response accuracy, consistency, and speed. The agent's job, however, is much different under an automated transit information system. ATIS operation involves an agent receiving telephone queries from a caller and retrieving desired information through the use of a remote interactive computer terminal located at the agent's work position. The system is activated when query data is entered on the terminal keyboard by the agent. The query is then processed in the computer

through preprogrammed routines selected by the agent which reference the geographic and transit data bases (addresses, fares, routes, schedules, etc.) and optimize certain caller-stated trip parameters (travel time, transfers, fare, walking distances, etc.) through comparison of potentially feasible alternatives. Following processing, which is accomplished in a matter of seconds, the most appropriate responses considering given caller-stated limitations are displayed on a cathode ray tube located above the agent's keyboard. This display is then evaluated by the agent and the appropriate information supplied to the caller.

1.1.4 ATIS Implementation Benefits

In light of the above discussion, it would appear that a well-designed and implemented automation of a transit information center would produce benefits to both the transit property and the general public. These benefits include the following:

1. Improved information agent service and productivity resulting from faster data retrieval by the computer.
2. Increased reliability and consistency of agent responses, since the computer should always supply the same answer to the same questions.
3. A reduction in training time for information agents, since extensive training in area geography and transit system characteristics is no longer necessary - this information would be stored in the computer's, rather than the agent's, memory.
4. Improved capability to rapidly incorporate schedule or other service changes into the information center's reference data base, since such changes would require only a simple modification of the computer's memory rather than reprinting or modifying hard copy reference data for all information agents.
5. Expanded capability to gather statistics about telephone information center operations since the computer can be programmed to store and compile all agent-directed functions and processing transactions.

6. The geographical and transit system data bases used as an integral part of the ATIS could prove a valuable source of information for other transit system departments such as those dealing with route planning, stop locations, and service schedules.

2.0 ATIS IMPLEMENTATION AT SCRTD

In this section, a brief history of implementation of the CCIS at the Southern California Rapid Transit District (SCRTD) is presented. Table 2-1 summarizes this history.

2.1 SCRTD TELEPHONE INFORMATION SYSTEM CHARACTERISTICS

The SCRTD's Telephone Information Facility embodies a number of characteristics that made it a prime candidate for ATIS implementation and testing. The Rapid Transit District's system is both immense and complex; the service area extends up to 90 miles north and south and 50 miles east and west in the Los Angeles Metropolitan Area. Within this area, over 200 SCRTD bus routes and 2400 buses serve 185 different communities and cities.

On an average day the SCRTD Telephone Information Facility receives between 10,000 and 13,000 calls on 83 different trunk lines covering the entire service area. To meet this demand, the SCRTD employs a total of 85 telephone information agents who answer calls in 3 shifts, 24 hours a day, 365 days a year. Despite this considerable investment in manpower, between 30 and 40 percent of all incoming calls are "lost" during peak demand periods; that is, callers who are put on hold by the telephone answering equipment because all agents are busy hang up before ever reaching an agent or receiving any information. During these peak periods, the agents answer calls at a rate of over 800 per hour.

In order to become thoroughly familiar with SCRTD's complex system, an agent must undergo an intensive eight-week classroom training session. At the end of this period, an agent should have a demonstrated ability to keep updated on operations, procedures, and policies of the SCRTD, as well as a working knowledge of the various bus routes. In the past, a minimum of six months of on-the-job experience has been required before an agent can be considered fully qualified to handle caller requests for information.

TABLE 2-1. COMPUTERIZED CUSTOMER INFORMATION SYSTEM: CHRONOLOGY OF SYSTEM DESIGN AND IMPLEMENTATION

DATE	SYSTEM STATUS
1970-72	Various strategies for improving telephone information service examined; computerized response idea supported by SCRTD management.
1973-74	PARIS system demonstration by System Development Corporation (SDC) in Santa Monica.
1975	Funding for hardware and software procurement included in SCRTD data processing capital grant application.
1976	Decision to implement a CCIS demonstration limited in scope to the San Fernando Valley.
1977	Preparation of system RFP's and selection of SDC as system design contractor through competitive process.
1977-78	Resolution of UMTA funding problems due to proprietary nature of SDC software.
1978	Beginning of technical system design.
1978	Construction of the digital geographic and transit system data bases.
1979	System operational; refinement and fine tuning process involving users and design contractor.
1979-80	Development of additional system improvements and system acceptance by SCRTD.
1980	Evaluation contractor, selected by UMTA, makes recommendations to increase system effectiveness.
1980	Controlled experiment conducted by evaluation contractor to evaluate comparative performances of CCIS and manual agents.

TABLE 2-1. Continued...

1981	Effectiveness recommendations implemented by SCRTD, with positive results on operator productivity and enthusiasm.
1982	Completion of system evaluation and development of additional system refinements, including installation of new telephone equipment.
1982	Decision by the SCRTD Board of Directors to expand the CCIS systemwide.

2.2 CCIS PROJECT ORIGIN AND BACKGROUND (1970-1977)

The origins of the CCIS project can be traced back to the early 1970's when the management of the SCRTD was examining various strategies for improving its services. One such strategy considered at the time was the utilization of a computer to support the customer information program. The General Manager of the SCRTD believed in and publicly supported this strategy, thereby laying the initial groundwork for further research in this direction.

The SCRTD's early optimism in the area was countered by a study on the potential of computer-based transit information retrieval systems. This study was performed by the National Bureau of Standards in Washington DC.* This NBS study indicated that, while small service area ATIS applications might be feasible, computer processing requirements for selecting appropriate itineraries increased geometrically with the amount and complexity of transit service provided. The study concluded there were no existing computer systems with sufficient capacity to handle large transit service areas in a responsive manner; in other words, the fastest computer retrieval speeds achievable for large computer systems were not comparable to those already achieved by agents using manual retrieval methods.

Despite this conclusion, the computer idea remained alive at the SCRTD due to monitoring of progress in 1973 for a local research and development effort conducted by System Development

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*Douglas R. Shier and Judith F. Gilsinn, Cost/Benefit Analysis of Automated Transit Information Systems PB268424 NBSIR 77-1253 final issue June 1977.

Corporation (SDC) in nearby Santa Monica. A researcher at SDC had focused his doctoral thesis on attempting to solve the algorithmic problem of computing transit itineraries for larger service areas within a demand-responsive time frame. This route-finding research was expanded into a corporate venture to develop a computer-based information retrieval system for the local Santa Monica Municipal Bus Lines, a small privately-held transit company. This effort resulted in a set of computer programs known as PARIS* (Passenger Routing Information System). This system became operational in 1974 and was used in a demonstration program by Santa Monica Municipal Bus Lines for approximately one year.

The successful operation of PARIS in Santa Monica was observed by senior SCRTD management including the Director of Customer Relations, who had budget responsibility for the Telephone Information Section, and the Director of Management Information Systems, who had budget responsibility for the SCRTD's computer area. Observing PARIS in operation convinced these senior managers that it was worth the risk to attempt installation of a pilot ATIS to support the SCRTD Telephone Information Section.

A limited, pilot ATIS deployment was considered desirable at SCRTD for two reasons. First, such an effort would give the SCRTD the opportunity to determine whether ATIS technology could actually perform in the context of a larger service area and a high level of transit bus service. Second, a limited test was deemed necessary since there was understandably much skepticism in the Telephone Information Section on the ability of this technology to perform a function which had been traditionally

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*PARIS is a trademark of SDC.

accomplished only by trained, experienced agents using printed reference material. Funding was requested by a separate line item in the SCRTD's 1975 data processing capital grant application. The line item covered both hardware and software for the pilot systems.*

The SCRTD service sub-area selected for testing this pilot system was the 300-square mile San Fernando Valley region north of downtown Los Angeles. This area was chosen for several reasons. First, it is geographically well-defined and of manageable size for a pilot application. Second, all calls from the Valley enter the SCRTD Telephone Information Center via a single trunk line, thus allowing for easy data recording and tabulation of calls. Finally, its 4000 streets and 32 bi-directional bus routes, including 1800 stops, are laid out largely in a rectangular grid network, which simplified the task of digitizing geographic and transit service characteristics in the computer's memory.

Due to the innovative nature of the project the capital grant process was lengthy. Visits were required by UMTA personnel to identify and discuss the nature of the project. The SCRTD was also required to write a subsequent justification of the project for UMTA review. A capital grant for $150,000 was finally approved in the spring of 1977. The key project justification was based on the planned CCIS using the SCRTD's mainframe computer (Univac 1106) on a timeshared basis. This strategy distinguished the project from another ATIS scheduled for UMTA funding at the Washington, DC Metropolitan Area Transit Authority (WMATA); this system was to be based on the use of dual dedicated mini-computers.

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* The software requirement specified "already existing" software as opposed to software development.

2.3 CCIS CONTRACTOR SELECTION PROCESS (1977-1978)

During the extended capital grant approval process, the SCRTD prepared an in-house draft Request for Proposal (RFP) and devised alternative procedures for the selection of a system contractor. One advantageous by-product of the delay in the project's implementation was the opportunity provided the SCRTD to observe the experiences of other transit properties, notably Philadelphia, which had entered the market for automated customer information systems. Three very valuable lessons were learned during this period:

- Hire only one system contractor.
- Recognize the sensitivities of the intended users (i.e., the agents and their supervisors) of this technology and strive to achieve an understanding of user needs through communications with them.
- Accept bids only from contractors who could demonstrate "working systems".

The strategy of hiring only one system contractor was based on Philadelphia's experience in 1975-1976 in which an attempt was made to install an ATIS to assist transit information agents during the Bicentennial period when a large number of tourists were expected to visit the city. This project was organized around three separate contractors: a mini-computer firm for the itinerary software, a microfiche firm, and a management firm to coordinate the other project consultants. This project organization proved to be ineffective in producing a well integrated team effort. The SCRTD observed this problem and made a decision to specify a single system contractor in the RFP.

The need to recognize the sensitivity of the transit information agent to ATIS technology was also confirmed by this Philadelphia experience. Agents in Philadelphia resisted the development and implementation of the customer information system because the project was partially justified on the basis

that they couldn't possibly handle the call demand expected during the Bicentennial visitor period. This justification, although well intentioned, offended their pride and lost their cooperation. Through observing this experience, the SCRTD became more aware of agent sensitivities to ATIS technology and other innovations:

- Agents take great pride in their expertise and their detailed knowledge of the service area and transit service.
- Agents place great value on learning through experience.
- Agents can respond to computer technology in a very negative manner if it is perceived as a threat to either job security or seniority.

The Supervising System Analyst who authored the SCRTD's RFP attempted to address these sensitivities by involving intended users in the process of identifying informational requirements which had to be satisfied by any form of customer information system. Draft portions of the RFP were circulated to the Telephone Information Section for review and comment. This process was not highly productive in terms of receiving input on informational requirements, but it was significant in that the users were involved in the procurement effort from the outset. This sensitivity to the users was also reflected in the membership of the Contractor Selection Committee, described below.

The decision to accept bids only from contractors who could demonstrate "working systems" was also the result of monitoring other ATIS procurement efforts. The bidding on the Philadelphia system and the bidding interest in the planned WMATA system (called AIDS) demonstrated there was several firms who were marketing ATIS packages which had already been developed and tested, though not necessarily sold to a transit agency. The SCRTD wished to avoid getting involved in a research and development effort with an unproved system's contractor and therefore specified the "working system" requirement for bidders.

In addition to the three RFP provisions which resulted from observations of the Philadelphia experience, two other requirements of the SCRTD's RFP were significant:

- The system hardware and software had to be compatible with the requirements of the SCRTD's in-house mainframe (Univac 1106) computer. This provision was in deference to the capital grant approval justification which specified an ATIS mainframe test. The contractor could, however, recommend the type of terminals to be used.
- The response time standard for retrieval of information on the ATIS was established at seven seconds or less assuming a "dry" system (no other jobs being run on the mainframe computer).

The RFP was completed and distributed in June 1977. The response period was initially eight weeks, but was later extended to twelve weeks at the request of one bidder.

During the RFP preparation process, the SCRTD formed a Selection Committee to evaluate contractor proposals and system demonstrations, and make a recommendation for contractor selection. The Committee consisted of the following SCRTD personnel (organized by department):

- Management Information Systems
  Supervising Systems Analyst
- Telephone Information
  Chief of Telephone Information
  Senior Instructor
  Senior Supervisor
- Planning - Scheduling Departments
  Advance Planner
- Purchasing Department
  Purchasing Representative

The committee membership reflected a continuation of the effort, mentioned above, to involve the user in the evaluation of contractors and proposed systems.

A total of five firms submitted proposals to the SCRTD for review by the September 16, 1977 proposal deadline. The general criteria established by the Committee to evaluate contractor proposals included the following (not necessarily in order of priority):

- Workability of proposed system:
  - Was the system technically sound?
  - Were the algorithms used to computer itineraries workable?
  - Was system operation based on proven logic?
- Computer Equipment:
  - Use of the mainframe computer and level of Univac system expertise
  - Recommended terminals for system and rationale for this recommendation
- Training Requirements
  - Ability to design and implement training program for agents at their level of comprehension and skill
  - Ability to work with agents
  - Interface with SCRTD Training
- Level of Knowledge on Transit and Telephone Information Operations:
  - Knowledge of transit bus operations
  - Knowledge of transit data base components (schedules, routes, stops and zones, fares)
  - Knowledge of transit telephone information operations
  - Knowledge of transit service area and geographic data base
- Ability to perform within Project Budget ($150,000)
- Ability to Support System after Implementation Logistics of Support

The fact that five firms responded to the RFP enabled the SCRTD to take a comprehensive look at the state of the art in ATIS technology. Each firm had at least one particular strength; the Committee eventually concluded they learned valuable information from dealing with each bidder. Without detailing the specific ratings of each firm, it is useful to summarize the major weaknesses identified in the process of evaluating all the losing bidders:

- Deficiencies in meeting training requirements (This weakness applied to all but one of the losers)
- Unworkable algorithm for system
- Inability to interface effectively with the users
- Inadequate knowledge of transit systems
- Resistance to use of Univac mainframe and inflexible approach on specifications of terminals for the system
- Lack of confidence in presenting the system
- Inadequate provisions for continued system support

When the rating process was completed, the Committee made a recommendation to the SCRTD Purchasing Department to select System Development Corporation (SDC), the same company which had run the Santa Monica demonstration. This recommendation was based on the following strengths in the sDC proposal:

- Ability to deliver a workable system which was judged as technically sound.
- A combined expertise of hardware/software and transit knowledge of SCRTD operations.
- Status as local California firm provided cost advantages in terms of system implementation and ongoing support.
- An effective plan for the use of project resources permitting a focus on the labor intensive data base tasks.
- A confident, well-organized system presentation to the Selection Committee.

A system presentation was also conducted for the SCRTD Board of Directors who subsequently agreed to the recommendation of the Selection Committee.

The contract between SCRTD and SDC was prepared and sent to Washington, DC in October 1977 for approval by UMTA. At this point, two legal problems developed which delayed the award of the contract until May 1978. The first of these problems involved the fact that the RFP had not been approved by UMTA

prior to being distributed. The second problem was that the legal nature of the contract was complicated by the fact that the SCRTD was, in essence, purchasing a license to operate a proprietary product (i.e., the SDC's PARIS program), a process not usually undertaken by the Federal Government, which is generally more interested in funding demonstration projects with the potential for application to other Federally-funded transit systems. After extended deliberations, UMTA proposed a way of resolving these two RFP approval problems. The UMTA proposal involved the SCRTD cancelling the original RFP, rewriting a second RFP, and re-advertising for bids with the intention of completing a two-phased procurement. The first phase of the procurement would cover the pilot project as previously advertised (the San Fernando Valley system), while the second phase would cover the SCRTD's entire service area. The SCRTD considered this approach and opposed it on two grounds. First, it was felt that the pilot project was required simply to determine whether an ATIS could be made to work to the satisfaction of SCRTD users and management, and making a full commitment to the entire service area was considered premature. Second, any commitment to lock the full service area into the 1977-78 level of technology was questionable, considering the pace at which cost-saving developments are made in the computer field. Such developments might well render the procured system obsolete in only a few years. The second legal problem, regarding the purchase of a license, meant that the SCRTD would not be purchasing the system programs themselves, but only the right to operate them for the San Fernando Valley portion of the service area. Additional time was required to enable SCRTD to comply with the federal requirements on purchasing such a license. The dispute over the RFP was finally resolved on February 20, 1978 when UMTA abandoned its previous objections and approved the original RFP. Upon resolution of the legal issues, it was necessary to recertify the bids on the project. When this task was completed the system contract was oficially approved and funding awarded in May 1978.

2.4 INITIAL TECHNICAL APPROACH AND COORDINATION

The contractor team was assembled in May 1978 to begin the project; the team consisted of four systems personnel with their combined expertise covering the areas of hardware, software, data base creation requirements, the PARIS programs, and the system training. The initial interface between the contractor and the SCRTD was necessarily a technical one involving the SCRTD's data processing personnel. The overall technical task facing this group was that of entering the contractor's system of programs on the client's computer. This task was complicated by the fact that the original PARIS programs were designed for IBM equipment. The SCRTD application was based on the use of a Univac mainframe thus requiring the conversion of all programs to a format compatible with the Univac compiler. Technical coordination meetings on systems-related issues lasted approximately eight weeks through June and July of 1978. The process eventually became so involved that the team finally agreed to a simple technical approach: the system would initially be installed in accordance with the contractor's proposal and later adjusted to any implementation problems as they appeared. The decision was made to rewrite the PARIS programs into Univac ASCII Fortran and 110 series assembly language. The contractor responded to this requirement by staffing the project with a systems analyst having extensive Univac-related software experience.

This initial project focus on technical issues produced a major problem early in the implementation process. Systems personnel had, in effect, stopped talking to users (the Telephone Information personnel) during this two-month technical design period. This silence made the users feel unrecognized as project participants and unappreciated in terms of operational input they could provide. This exclusion from the project design contributed to a lack of user confidence in the potential of the CCIS to support telephone information operations.

This inadvertent user exclusion was recognized by system personnel in August 1978. To address the problem a decision was made to hold weekly project meetings with Telephone Information personnel. These meetings made systems personnel realize they had a responsibility to try to translate computer terminology and technical discussions into layman's language; they also realized the need to learn more about the user's world before designing system features of the CCIS.

These weekly meetings also made the senior Telephone Information section staff realize they had a reciprocal responsibility to learn the basics of computer systems and data processing; this knowledge would enable them to understand and effectively contribute to the technical design process. In the fall of 1978 the senior management and instructional staff of the Telephone Information section enrolled in an introductory data processing course at a local university; each staff member successfully completed the course. At the same time the systems staff were devoting time to learning more about data processing requirements from the transit information agents. It might be noted that systems personnel felt, in retrospect, that the best way for them to become familiar with user requirements would have been to enroll, like new agents, in the official SCRTD eight-week training course.

Within three months the implementation approach was thus transformed into a more participatory effort involving effective dialog between system technicians and users. The time required in this necessary coordination effort necessitated a twelve week extension in the overall project schedule.

2.4.1 Establishment Of The Geographic Data Base

The next step in the system implementation process, creation of a geographic data base for the San Fernando Valley, involved the laborious task of digitizing all the street addresses in the service area. Street address ranges were encoded on a coordinate

grid for the straight segment of every street, along with start and end addresses for each segment. This process is aided by the use of a machine called a "digitizer" which automatically identifies x-y coordinates when its pointer is placed on a map.

At the time this task was initiated (the summer of 1978) digitized geographic information was not available from the U.S. Census Bureau. The contractor was thus faced with the options of digitizing either manually or by machine the street address network and various local landmarks. Efforts to locate an appropriate digitizing machine led the contractor to the University of California at Los Angeles (UCLA), where a flat bed digitizing machine system was available. An agreement was secured by the contractor permitting use of this system two hours a day for two months.

The contractor operated the digitizing machine using large wall size commercial maps of the San Fernando Valley; these commercial maps were considered to be the best available data base on the current street network in the Valley. These maps were larger versions of those contained in the commercial map guide (Thomas Guide) used by the transit information agents.

The two month machine digitizing effort originally anticipated was not sufficient to complete the task due to the size and extent of the street address network and the limited access time to the machine. In addition, the productivity of the machine digitizing effort was constrained by the use of inexperienced personnel for this task. The contractor was thus forced to rely on manual digitizing to complete this work. The manual method involved a "ruler and eyeball" approach to determine the map coordinates of a location or point; this procedure proved to be very laborious and error prone. Errors made in the initial geographic digitizing effort were corrected over an extended period initially through contractor quality control checks and later by verification of system "trouble reports" completed by agents.

The entire experience with digitizing in CCIS implementation made the SCRTD and the contractor recognize that future efforts should include a much greater cost and time allocation for completion of this process.

2.4.2 Establishment Of The Transit Data Base

The data elements required to describe the operating characteristics of the SCRTD bus service included the following:

- Bus routes
- Bus stops and fare zones
- Bus operating schedules
- Bus fares

The level of difficulty experienced by the contractor in creating this transit data base was exacerbated by three technical and institutional factors. First, there was no centralized SCRTD transit data base; each of the above elements fell under the jurisdiction of a different SCRTD department. Second, there was no standard format for the transit data required for the CCIS data base. SCRTD departments also used different (IBM) data processing system hardware, thus precluding automatic data entry into the mainframe computer (Univac) supporting the CCIS. Finally, interdepartmental cooperation was difficult to achieve since the potential benefits of the CCIS data base were not fully understood by other departments at this early stage in the implementation process.

The geographic pattern of SCRTD bus service in the Valley was determined by the 32 bi-directional bus routes and the associated network of 1,800 bus stops. Bus routes were under the jurisdiction of the Planning Department while bus stops were handled by the Stops and Zones Department. Bus routes were described in printed reference material while the master list of stops and zones was contained in a word processor (VYDEC) listing.

The contractor used these source data to integrate the bus route-bus stop network into the CCIS data base. Routes and stops were digitized using the flat bed system located at UCLA; this

effort was labor-intensive and similar to the street network digitizing task. Due to recurring accuracy problems the contractor actually re-digitized the entire stops and zones list using the manual method. Bus stop additions and changes also required additional manual digitizing throughout the implementation period.

Bus operating schedules at the SCRTD were maintained by the Scheduling Department. The schedule data were stored on tapes known as the B.O.S. (Basic Operating Schedules) and processed on an IBM 1401 computer. The B.O.S. system printed out time tables on bus operations which delineated specific time points for each bus run. These time tables were produced for human use and were not directly computer usable. Consequently, bus schedule data were integrated into the CCIS data base by reading the B.O.S. tapes rather than the hard copy schedules, directly into the mainframe (Univac 1106) computer. This integration was a lengthy task due to data and tape editing requirements. One important CCIS schedule data subtask related to the need to interpolate bus run time points in those cases where explicit data were not provided. This effort required calculations of bus speed on the particular run in question. Speed calculations varied according to the type and time of the day of the bus service, e.g., peak vs. off peak, day vs. night, surface vs. freeway, etc.

After entry of the B.O.S. tapes, the main schedule file was stored in the mainframe computer. Individual schedule changes or corrections could then be made using a remote terminal. More extensive bus system scheduling changes (which occur every few months) required reading an entire new schedule tape into the mainframe computer, superseding the old tape information. Since the pilot CCIS was only required to be able to provide information on current bus service (and not planned service) it was important for the implementation team to coordinate closely with the Scheduling Department on the use of the correct B.O.S. The

final element in the CCIS transit data base was the fare structure. This fare information was obtained from printed SCRTD reference material and entered directly into the CCIS data base using a terminal.

It is estimated that development of all data inputs for the CCIS, including the geographic and transit data bases, cost the SCRTD approximately $50,000.

2.5 USER PARTICIPATION IN SYSTEM DESIGN AND FINE TUNING

The technical foundation of the CCIS was based on the conversion of the PARIS programs for application to the SCRTD's mainframe computer, and the creation of the geographic and transit data bases for the San Fernando Valley. By November 1978 substantial progress had been made in both these areas. The SCRTD had also received delivery of the computer terminals for the CCIS; there were eight cathode ray tubes supplied for the pilot system, and the contractor was able to develop sample format and response screens for system operation. Hardware and other system improvements cost the SCRTD an additional $50,000.

The implementation effort now moved into the phase of designing system operating characteristics which would satisfy user operational requirements. This design was a critical phase in project implementation since systems personnel faced a significant technical challenge while user personnel were still quite skeptical over the ability of the system to actually work. In fact, several of the senior user staff were convinced at this point that the system could never be developed to fully satisfy user requirements. To achieve successful system design, it was essential for the computer team to get users to specify in detail their operational requirements. Given this skepticism, the standard design procedure over the next few months was as follows: the implementation team would propose a system feature (e.g., a certain format or response screen) to the user; typical user reaction was

"that doesn't work" or "that's unsatisfactory" followed by "but this is what you really need to do to meet our needs." The nature of this user response was significant in that despite the skepticism, it did specify a given solution. In this manner the users became a very effective, although somewhat reluctant partner in an incremental system design process. In the Telephone Information Section, the Chief Instructor and her supervisors were particularly helpful in making this operational dialogue worthwhile.

The CCIS route-finding algorithms allow an agent to specify either a minimum travel time route or a minimum bus transfer route for the purpose of ranking the bus itinerary options which would satisfy a given trip request. The system technicians and users became involved in a process of determining the relative customer demand for these two alternative outputs. System itinerary rankings were initially based on minimum travel time and weighed all travel time options equally with the exception of a five-minute penalty for a transfer. Subsequent weighing schemes worked out with agents and supervisors increased the penalty for a transfer from a minimum of 30 to a maximum of 45 minutes. This penalty reflected a long-standing Information Section policy of attempting to serve patrons with only one bus whenever possible. It also reflected operational considerations regarding the routes of two heavily used "horseshoe" shaped bus lines serving the Valley area.

Users and system technicians also became involved in a process of refining machine selection of appropriate bus stops. Given the caller's desired origin and destination points, the machine was programmed to "scan" an area within a specified radius for any stops on bus routes appropriate to the caller's itinerary. Initially, this radius was set at one-half mile from these points, under the assumption that most riders would be willing to walk this distance. This radius was decreased to one-quarter mile at the request of the supervisors.

System designers also modified the CCIS stop-selection capabilities, at the request of the users, to include a routine for identifying the nearest bus stop to an origin or destination point on a user-specified bus line. Most agents could select appropriate bus lines for a given itinerary from memory, but were forced to consult system maps (Thomas Guides) for stop location information. With this computer enhancement, this added manual consultation was no longer necessary.

Supervisory personnel became involved in this system refinement process in January 1979. A small group of volunteers was recruited to operate the evolving system and provide additional feedback on user requirements. Weekly meetings were held between agents and designers to demonstrate system status and solicit recommendations for future improvements. Agent ability to specify very practical day-to-day requirements resulted in the development of several valuable system features, such as system specification of the direction of bus travel along the street route, an especially useful feature with the "horseshoe" shaped bus routes.

Interaction between the user and the system personnel identified many additional technical problems to be resolved. User abilities to identify problems and contractor's ability to formulate feasible solutions to them proved to be the key to continuing progress in system design. In this process, system operating characteristics were increasingly correlated with user specifications, and the CCIS gradually gained more credibility with the agents as an information retrieval tool.

2.6 DEVELOPMENT OF THE AGENT TRAINING PROGRAM

The development of the CCIS agent training program necessarily followed the system design process described above, which gave the CCIS its technical and operational definition. By March 1979, the system was considered sufficiently developed to begin

training some regular agents in the work force. This training effort faced several difficulties. First, since the technology was the first of its type to be implemented at any transit authority, an agent training program had not been attempted previously. The absence of an industry track record in this area left the implementation team without any guidelines to follow. Second, the major instructional expertise at this point resided with the contractor team since they had developed the system; an official training course could not be developed by the SCRTD this early in the project. Third, operation of the system involved a major change in agent work habits, involving typing, keyboard manipulation and reading of response screens from the CRT. Fourth, the system data bases were not fully refined at this date. Fifth, many of the agents, whose average education level was that of high school graduate, were understandably apprehensive about learning how to operate this new technology. As a result, only a few in the user group, including agents and senior staff, believed that the CCIS could really perform up to the required standards for day-to-day usage. Given this set of circumstances, the agent training program was initiated by requesting volunteers. These volunteers were organized into small groups for instructional purposes. Contractor staff conducted the initial training effort which consisted of 8 hours of classroom instruction and 8 hours of terminal practice. The contractor prepared a "CCIS Users Guide and Training Manual" for the use of the agents. The training course was soon reduced to 4 hours of instruction and 4 hours of terminal operation; this change was made based on the recommendation of some senior agents who considered the 16-hour course unnecessarily lengthy; all the agents trained in CCIS use at this point were staff who had successfully completed the SCRTD's eight-week agent orientation program. A total of 32 agents initially received training from the contractor.

SCRTD training staff, which until this point had taken responsibility for all training functions, became involved with the CCIS through the offering of a short "refresher" course for the initial trainees. By June 1980, the balance of the agent work force (approximately 45 more personnel) had been trained by SCRTD staff using the 8-hour program developed by the contractor.

The effectiveness of this initial training effort was difficult to assess at the time. More light was shed on this area as a result of agent interviews and opinion surveys, discussed in Section 3.5 below, conducted in 1980 and 1981. There were clearly a few agents who benefited from the initial training and who were highly motivated to use and master this technology; conversely, there were some who reacted quite negatively and wanted no part of the CCIS. Most agents, however, fell between these two extremes. They felt that they had been exposed to a promising technology but not subjected to an intensive enough operational instruction course to make effective use of it.

2.7 SYSTEM ACCEPTANCE

Approximately one year after the contract award, the CCIS was operational and could perform according to the minimum requirements specified in the RFP. The system data base had been created (although it remained error-prone in some areas), the information retrieval programs were functioning, and transaction response time was within the standard specified. It was evident at this point, however, that a longer "debugging" and refinement period would be required to bring the system to the point where users had confidence in its operation.

The SCRTD officially accepted the CCIS on June 4, 1979 in accordance with the terms of the contract.

2.8 SYSTEM IMPROVEMENTS AND USER ACCEPTANCE (1979-1980)

After system acceptance, operational deployment of the CCIS in the SCRTD Telephone Information Center consisted of seven regular

agent work positions equipped with CRT terminal units, with an additional unit used for system updating. Each position was provided with telephone equipment capable of answering calls on both the San Fernando Valley area (Van Nuys) and the Downtown Los Angeles Area trunk lines. Because CCIS capabilities were limited to the Valley area, agents were instructed to place high priority on Van Nuys trunk calls, and handle calls on the downtown trunk only if there were no Van Nuys calls, a circumstance which occurred only rarely. In order to answer downtown area trunk calls, as well as any calls for itineraries originating in the Valley, but traveling to destinations outside the CCIS's geographic scope, agent work positions were also equipped with all the indexed schedule materials available for manual data retrieval. Agents were encouraged to use the CCIS as much as possible, but to double check any suspicious response screens against the manual hard copy data.

The first year of CCIS operation was actually a continuation of the system implementation "shakedown" period in which agent experiences with CCIS call processing resulted in identification of numerous areas where further improvements were required. Technical improvement efforts by the system contractor included the following:

- Corrective actions - where errors in system data base or operations were detected and corrected.
- System refinements - where improvements were made to existing system operating features.
- System enhancements - where new technical features were added to improve overall system performance.

Corrective actions were greatly facilitated through establishment of a trouble reporting system. When there was a question concerning the validity of any CCIS response screen, it was the agent's responsibility to verify manually the suspected error and to document this discrepancy on a trouble report. These reports

were submitted to shift supervisors, who subsequently turned them over to the system contractor for verification and/or correction. Examples of errors detected and reported included schedule data inconsistencies, wrong bus stop locations, improperly digitized street addresses or landmarks, and "bizarre" bus itinerary responses.

As might be expected the initial number of trouble reports was quite high; this situation was due to the newness of the system and the fact that multiple reports of the same erroneous data were made. A trouble report response procedure was established whereby each agent submitting a report was provided with an answer explaining the discrepancy observed and the corrective action taken, if any. Interestingly, there were several cases in which the perceived "bizarre" bus routing reported was actually deemed the "best" routing in light of the query input. Such cases were valuable in that they demonstrated the educational potential of the system, even for experienced agents. Review of these cases resulted either in a change of the agent's comprehension of the system, or in a modification by the contractor of the various weighting factors in the system's route-finding algorithm. By mid-1980, there were very few trouble reports being submitted by the agents, indicating that the system was approaching a relatively high degree of accuracy.

Refinements to the system focused on improving system operating features with the objective of promoting more effective system usage by the agents. Areas that received improvements included the following:

- Estimation through interpolation of schedule time points, using realistic bus speeds.
- Better identification of streets traveled along a given bus route, and direction of travel along those streets at given times.

- Integration into the system of school bus trips, which use the same route and line numbers as regular buses.
- Continued intensive study of weighting factors to determine rankings for bus itinerary options. This was the most extensive effort of the system refinement process, since its major objective was to enable supervisors and agents to better understand the designer's rationale behind responses provided.

Enhancements to the CCIS made during this improvement period included:

- The addition of a "forced" routing transaction. This transaction enabled agents to specify a "preferred" bus line prior to requesting a system itinerary response. The system was then "forced" to respond with an itinerary which included the particular bus line requested. This transaction proved to be a valuable addition to the CCIS from a marketing standpoint, as in many cases, callers familiar with a certain route persist in requesting information regarding that route even when informed that it is not the "best" available. Forcing the system to use a certain route saved the agent from time-consuming back-checking of manual data and at the same time met the demands of the caller.
- Changes to the schedule request transaction to allow for "shortlining" in which a certain bus reverses direction at the request of the dispatcher without completing its full route.
- Correlation of geographic locations listed on response screens with the page number and map coordinates of those locations in the agent's system map book (Thomas Guide). This feature enabled agents to locate itinerary origin, transfer, and destination points much faster when necessary and facilitated the provision of walking instructions.

- Reduction of average system response time by eliminating the need for the system to consider certain routing solutions.
- Investigation of alternatives for providing walking instructions using video display systems with slide projections of Thomas Guide maps. Since the CCIS explicitly lacks the capacity to provide walking instructions, the development of alternatives to improve agent productivity in this area was given considerable attention.

The technical improvement period resulted in a more accurate data base, more user features, and more responsive system operation. It raised the CCIS to a level of technical maturity where the user could comfortably and effectively operate the system. At this point, further system progress depended more upon increased and managerial support within the SCRTD.

2.9 EVALUATION CONTRACTOR RECOMMENDATIONS IN SUPPORT OF SYSTEM IMPLEMENTATION

During the summer of 1980, a contractor, Wilson Hill Associates, Inc., was named by UMTA through its Transportation Systems Center to conduct an independent socio-economic and performance evaluation of the CCIS. This evaluation was intended to measure specific impacts on user performance and productivity as well as more general impacts on the SCRTD's marketing program. Early assessments of the system by this contractor indicated a number of institutional problems that were hindering its use; in mid-1980 agents were at best consulting CCIS only intermittently. They often double-checked response screens against manual references, thereby greatly slowing down their response times and decreasing their productivity. It was obvious that the technical improvements to hardware and software described above were only part of the effort needed to enable the pilot system to achieve its full potential. User attitudes showed that the SCRTD also needed to

make a stronger commitment to the human component of the system: the users. This commitment was required from the Telephone Information Section and several other SCRTD departments.

The SCRTD Director of Consumer Relations worked with the Information Section to implement a set of six evaluation contractor recommendations designed to promote CCIS usage and effectiveness. These recommendations included:

- Establishment of a CCIS Working Committee - this committee established objectives for system usage, identified CCIS related problems, recommended solutions to identified problems, and monitored system data to ascertain the achievement of objectives. Committee membership included senior personnel from the Telephone Information, Computer Operations, Scheduling, Planning, and Stops and Zones departments.
- Appointment of a supervisor as full time CCIS Program Manager - this program manager was responsible for effective CCIS operation and served as the intermediary between the CCIS agents and the system technicians, effectively "speaking the language" and satisfying information needs of both.
- Development of strategies with Computer Operations to improve CCIS response times - a strategy was designed to support responsive CCIS transactions on the mainframe computer by scheduling other major computing jobs (e.g., SCRTD payroll computations) during late-night periods of low call demand.
- Creation of a new program for CCIS agents involving re-training and improved status and support - all agents desiring to work the CCIS were asked to volunteer for new training which was followed by a testing and certification process; agents were assigned to more desirable

daytime work shifts and provided with a steady support program for resolving CCIS-related problems.

- Development of a program for greater interdepartmental cooperation in supporting the CCIS transit data base - this program was aimed at developing more effective procedures for receiving and updating data from the Scheduling, Planning, and Stops and Zones Departments within the SCRTD.
- Use of the CCIS log file system data collection program for analysis of system and agent performance - the contractor expanded the CCIS log file program to permit the calculation of performance measures for the whole system and for individual agents; these data were used by the CCIS Program Manager and the Working Committee to analyze system operations and evaluate agent progress and skill development.

These recommendations were substantially implemented between November, 1980 and February 1981. Their implementation represented a breakthrough in enlisting user support and enthusiasm for the system. In addition, establishment of the Working Committee caused other SCRTD departments to recognize the potential of the CCIS data base as a valuable resource. The agents responded positively to these recommendations, and 42 of the 85 agents in the Telephone Information Department volunteered for CCIS retraining. By February 22, 1981, the CCIS was considered ready for an official 90-day evaluation of system operation, performance and impacts.

2.10 CONCLUSIONS REGARDING SYSTEM DEVELOPMENT

In retrospect, it can be stated that the early criterion established by the Contractor Selection Committee of accepting only "workable" systems or "existing" software was somewhat of a myth. The sheer magnitude of the effort required to implement the CCIS so totally outclassed SDC's previous efforts with the PARIS system in Santa Monica that they were required to start

almost from scratch.

It appears unlikely, given the unique service networks, as well as departmental and institutional frameworks of most large transit authorities, that the CCIS would be directly transferable to other transit properties without extensive modifications to system software. Other properties can, however, learn from major implementation problems at SCRTD and plan accordingly. For example:

- Creation of the geographic data base requires a very labor-intensive effort which is greatly facilitated by use of state-of-the-art digitizing equipment;
- It is extremely important to secure and hold confidence of system users from the outset by seeking their ideas and opinions;
- Cooperation from other authority departments is essential to construction of the transit data base; and
- A comprehensive management system made up of representatives of all parties (users, contractor, Marketing Department management, and other affected departments) should be implemented as an integral part of the process. This system should have as its chief function the facilitation of responses to perceived implementation problems as they arise.

3.0 SYSTEM EVALUATION

With the full cooperation of the system design contractor and the management and staff of the SCRTD Telephone Information Section, Wilson Hill Associates in the summer of 1980 designed a comprehensive program for collection and evaluation of data concerning the CCIS. These data were collected between October 1980 and June 1981. The major goals of this program were to determine, as accurately as possible, answers to the following questions:

- In what ways does the CCIS affect the Telephone Information Section's productivity, i.e., the overall quantity of agent responses provided?
- In what ways does the CCIS affect the quality, i.e., the accuracy and consistency of agent responses provided?
- How does the CCIS affect an average agent's performance of normal job functions? How does it change the agent's perception of his/her job?
- What impacts does the CCIS have on the training process for new agents?
- What other impacts, positive or negative, does the system exert on other SCRTD departments? On the general public?

A number of different data collection instruments were implemented as elements of this evaluation program, taking advantage of a variety of different information sources. In this section, efforts at quantitative impact measurement are presented first; qualitative evaluation efforts are then described.

3.1 QUANTITATIVE DATA COLLECTION

In evaluating the quantitative impacts of the CCIS, Wilson Hill had three primary objectives:

- To determine through measurement of call volumes the characteristics of consumer demands placed on the Information Section, both from the San Fernando Valley (the CCIS test area) and from the entire SCRTD service area.

- To ascertain as accurately as possible the performance of the CCIS agents, as compared with their manual counterparts, in responding to these demands.
- To gain a detailed understanding of the characteristics of CCIS calls.

Four separate types of data were used in the achievement of these objectives. these were:

- Automatic Call Distribution system counts;
- Van Nuys trunk daily call counts;
- CCIS internal log file statistics; and
- Agent performance data recorded under controlled experimental conditions set up by the evaluation contractor.

3.1.1 Automatic Call Distribution System Data

The SCRTD uses a Stromberg-Carlson Automatic Call Distribution (ACD) system to route incoming calls to the information agents. This equipment receives calls on 83 separate trunk lines. When a call is received, it is transferred directly to an available agent. If all agents are busy, the call is routed to a holding queue from which calls are routed in a first-in, first-out sequence. This ensures that the caller who has waited the longest is handled by the next available agent. While holding, a caller receives a recorded message stating that all operators are currently busy and requesting that the caller organize his/her question before the operator comes on the line.

The ACD system is a valuable source of data concerning both caller demand and agent performance. Using a device called a "peg counter," it mechanically records the number of calls entering the system and the number of calls which are "lost," i.e., those which are ended by the caller before reaching an agent. On a form labeled "Trunk Group Readings," incoming calls and lost calls are recorded from the counter each hour by SCRTD supervisory personnel. Once these data are recorded, the ACD

counter is reset to zero for the next hour's count. All calls from the San Fernando Valley, the CCIS test area, are recorded by this system in a single trunk group (the Van Nuys Trunk). This circumstance facilitated comparisons between caller demands and agent performance for both CCIS and manual agents.

It might be noted that several of the management personnel in the Telephone Information Section expressed reservations concerning the accuracy of the Trunk Group Readings. The ACD system operating during the period of data collection was relatively old and was experiencing numerous component malfunctions. The entire system was replaced with new equipment in July 1981. Despite these reservations ACD data were still used quite extensively by SCRTD throughout the data collection period as indicators of agent performance and caller demand.

3.1.2 CCIS Log File Data

In the early stages of CCIS implementation, the SCRTD found it useful to monitor CCIS agent progress by taking detailed ACD counts of the number of calls answered by each CCIS agent each hour. These data were compiled on forms labeled "Van Nuys Daily Call Count."

The CCIS log file, which superseded the Van Nuys Daily Call Count as a data collection device for the Van Nuys trunk, is an extremely valuable data collection component which takes advantage of the system's inherent data storage capabilities. Its development was an outgrowth of the SCRTD specification which required that the system be capable of producing hard-copy records of all transactions. Such transaction records were potentially useful for analysis but rather unwieldy in terms of length and detail. In consultations with SDC and the data processing staff at SCRTD, a computer program was developed which automatically produced a daily compilation of certain system statistics. This program was a modification of a data reduction and report production program developed earlier by SDC for its own use.

The CCIS log file includes information on all aspects of system performance. In most instances this information is presented both for each individual agent and for the entire system (usually seven agents). Log file results are compiled during CCIS operational hours (6 am to 6 pm) and a record is kept of each day's transactions.

The accuracy of the CCIS log file was independently established by random spot samples of calls conducted by the evaluation contractor, using monitoring equipment available at the Telephone Information Section. By eliminating human error in the data collection process, the CCIS log file provided a complete and detailed history of CCIS operations. Data items recorded on the CCIS log file are listed in Table 3-1.

One drawback of the CCIS log file is that data are compiled only for those calls which are answered using CCIS equipment. No records are kept of total calls or lost calls on the Van Nuys trunk. For this information, the evaluation contractor was forced to rely on the less accurate Trunk Group Readings from the ACD system.

3.1.3 CCIS Controlled Experiment Data

While the above-mentioned sources offered a wealth of information concerning various aspects of Telephone Information Section operations, they still did not provide a completely unbiased comparison of performance between the CCIS and manual modes of information retrieval for impact analysis. Several factors inherent to the system created comparison problems:

- Those agents trained for CCIS are generally more experienced than the average agent. This situation is due to the fact that the CCIS was operational during the day shift (6 am - 6 pm), the shift most preferred by Section employees. Since shift assignments are made on the basis of union seniority,

TABLE 3-1. CCIS LOG FILE DATA
COMPILED DAILY

OPERATOR DATA:	Agent ID numbers and logon/logoff times
CALL DATA:	Call count by terminal, total calls
	Manual call count by terminal, total manual calls
	CCIS call count by terminal, total CCIS calls
	Number of calls by hours of day, 6 am-5 pm
CALL TIME DATA:	Average call time by starting hour
	Average call time by terminal, CCIS and manual
	Average CCIS call time by terminal
	Average manual call time by terminal
	Call count by classes of call duration
	Percent of calls in each duration class
	Overall average call time
	Overall standard deviation of call times
	Projected calls per hour by terminal, manual and CCIS
	Projected calls per hour by terminal, manual calls only
	Projected calls per hour by terminal, CCIS calls only
TRANSACTION DATA:	Total transactions
	Processing transactions
	Transaction count by type
	Transaction count by terminal
	Transaction count by hour
	Transaction count by type for each terminal
	Computed itineraries
	Return itineraries computed
	Transactions per call

TABLE 3-1. Continued...

RETRIEVAL TIME DATA:	Retrieval count by duration class, all transactions
	Retrieval % by class, all transactions
	Retrieval count by class, computed itineraries
	Retrieval % by class, computed itineraries
	Retrieval count by class, all but computed itineraries
	Retrieval % by class, all but computed itineraries
	Average retrieval time
	Standard deviation of retrieval time
ERROR DATA:	Total errors
	User errors by terminal
	System software errors by terminal
	System hardware errors by terminal
OTHER CCIS DATA:	Average computer time per CCIS call
	% of CCIS calls used in retrieval
	Average time from beginning of call to first transaction
	Average time from last transaction to end of call

those CCIS-trained agents having longer job tenure generally elect and receive CCIS duty.

- The configuration of the ACD hardware which routes calls to agents generally ensures a shorter queue on the Van Nuys trunk line than on the other trunks. As a result, callers usually experience a shorter holding period on the Van Nuys trunk than on the others. It is likely that this shorter wait is reflected in fewer lost calls on the Van Nuys trunk.
- CCIS agents, during normal operations, do not exclusively use the computer for data retrieval. Because the CCIS data base contains information on only a portion of the total SCRTD service area, agents occasionally receive requests for routings to destinations outside the system's geographic limits. To handle these requests, agents must resort to manual retrieval. In addition, on rare occasions when there are no incoming calls on the Van Nuys trunk agents are instructed to answer calls originating on the downtown Los Angeles trunk. Handling these calls implies manual retrieval, since the caller's origin is also outside the system's scope. Even in instances where the CCIS can handle both origin and destination data, agents often double-check response screens which they deem questionable against the manual data.
- The calls handled by the Information Section are themselves inherently variable. One caller could have a single request that required a 3-second response, while another might have multiple itinerary queries that demanded up to 10 or 15 minutes' response time.

As a result of these factors, the evaluation contractor realized that a direct comparison of data retrieval modes based only on system operations data would not be possible. In order to make such a direct comparison in which bias was eliminated, an artificial environment was required in which all of the above-mentioned factors were controlled. With the assistance of the SCRTD, the contractor created such a controlled experimental setting in November 1980. In this setting, nine SCRTD agents were tested. Each agent was queried with the same set of 36 itinerary questions concerning transit service in the CCIS service area. These questions were developed by the Information Section with the assistance of evaluation contractor personnel. They were designed to test both the capabilities of the agents and the system. The nine agents represented three modes of information retrieval and three levels of agent skill and experience. The experiment was conducted by two members of the contractor evaluation team, who alternated in performing the roles of caller and observer. The caller made the test calls from a separate room and recorded the agent responses on a log form. The observer was located in the same room as the test agent, but out of direct view; total call times were logged by the observer using a stop watch. Agent responses and response speeds for the various retrieval modes and skill levels were later compared and evaluated.

3.2 QUANTITATIVE EVALUATION METHODOLOGY

The wide variety of quantitative data sources described above necessitated the development of a number of different evaluation strategies.

For the ACD, Van Nuys trunk, and CCIS log file data, it was decided that a 90-day period of data collection during steady-state operation of the CCIS would provide an adequate information base for impact evaluation. This period was considered to be of sufficient duration to average out any observed extremes in data variability, and to ascertain general trends, if any, in variables studied. The mode of evaluation used for these three data sources might therefore best be termed "interrupted time-series with a nonequivalent control group." In essence, both the experimental group (the CCIS agents) and the control group (agents on trunk other than Van Nuys) were measured repeatedly over the 90-day evaluation period. "Interrupted" merely signifies that data collection was not continuous, since the CCIS log file was operational only between 6 am and 5 pm. This experimental design is considered one of the best available for eliminating extraneous factors as explanations for observed changes.*

Not all of the measures collected in the 90-day evaluation period fit into this experimental design. In fact, most of the variables compiled on the CCIS log file could not be obtained for the manual agents; for these variables the experimental methodology might best be called "interrupted time-series without control group."**

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* Mark S. Sanders and Denis J. Sullivan, An Experimental Design Plan of SCRTD Computer Customer Information Service, Canyon Research Corp., Dec. 1977, p.8.

** Ibid., p. 9.

In the case of the controlled experiment, extended data collection was not possible due to logistical reasons. During the course of this experiment, a total of 324 agent responses were recorded and timed. Experimental conditions were sufficiently controlled so that an analysis of variance could be performed on these observed response times. The analysis of variance is a statistical method of dividing the variation observed in experimental data into different parts, each part assignable to a known source or cause. It allows the evaluator to assess the relative magnitudes of variation that are the result of each of the independent variables, which in this case were agent experience (novice, intermediate, or advanced) and mode of data retrieval (CCIS only, manual only, or a mixture of manual and CCIS).

3.3 QUANTITATIVE EVALUATION RESULTS

The analyses presented below are based on the following data made available to the evaluation contractor by the SCRTD:

- Van Nuys ACD daily call count forms covering the period from November 23, 1980 to February 22, 1981.
- CCIS log file printouts covering the period from February 22, 1981 to June 4, 1981. Although the system was functioning continuously during this period, log file data for March 10, March 31, April 26 through May 2, and May 22 were not made available to the contractor.
- ACD Trunk Group Reading forms covering the period from February 21 to May 22, 1981.

Based on the data provided, it was decided that the 90-day evaluation period would run from February 22 to May 22, 1981. Due to the missing week of CCIS log file data at the end of April, most log file-based trend analyses were extended an

extra week to May 30, 1981. The CCIS Controlled Experiment is the subject of a companion report prepared by Wilson Hill.* Since the companion report contains detailed analyses of experimental results, only the most salient conclusions on agent call times will be presented in this report. These conclusions follow the descriptions of caller demand, agent performance, and call characteristics below.

3.3.1 Characteristics of Caller Demand

Using the ACD data, all calls received by the Telephone Information Section on all trunks between 6 am and 5 pm were totaled for each day of the 90-day period. Totals for this time span for each day in the test period are presented in Appendix A. Calls received on all trunks during this time period ranged from a low of 4336 on Sunday, March 1 to a high of 9382 on Monday, April 7. The average number of calls received daily on all trunks for the entire test period between 6 am and 5 pm was 6723; the standard deviation was 1413.

Total calls received by the section were averaged for each week of the test period; the results are shown in Figure 3-1. From Figure 3-1, it can be seen that caller demand varies considerably from week to week. The first 6 weeks of the test period were characterized by relatively high caller demand, with calls averaging 7134 between 6 am and 5 pm. The next 7 weeks, beginning April 5, show appreciably lower demand, with an average 6 am to 5 pm count of 6370.

Of particular interest in the ACD data were calls received by the Van Nuys Trunk serving the CCIS. These readings were totaled for the hours 6 am to 5 pm for each day of the test period; these total calls are shown in Appendix B. Calls

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* Robert E. Furniss and Robert O. Phillips, The CCIS Experiment: Comparing Transit Information Retrieval Modes at the SCRTD, Wilson Hill Associates

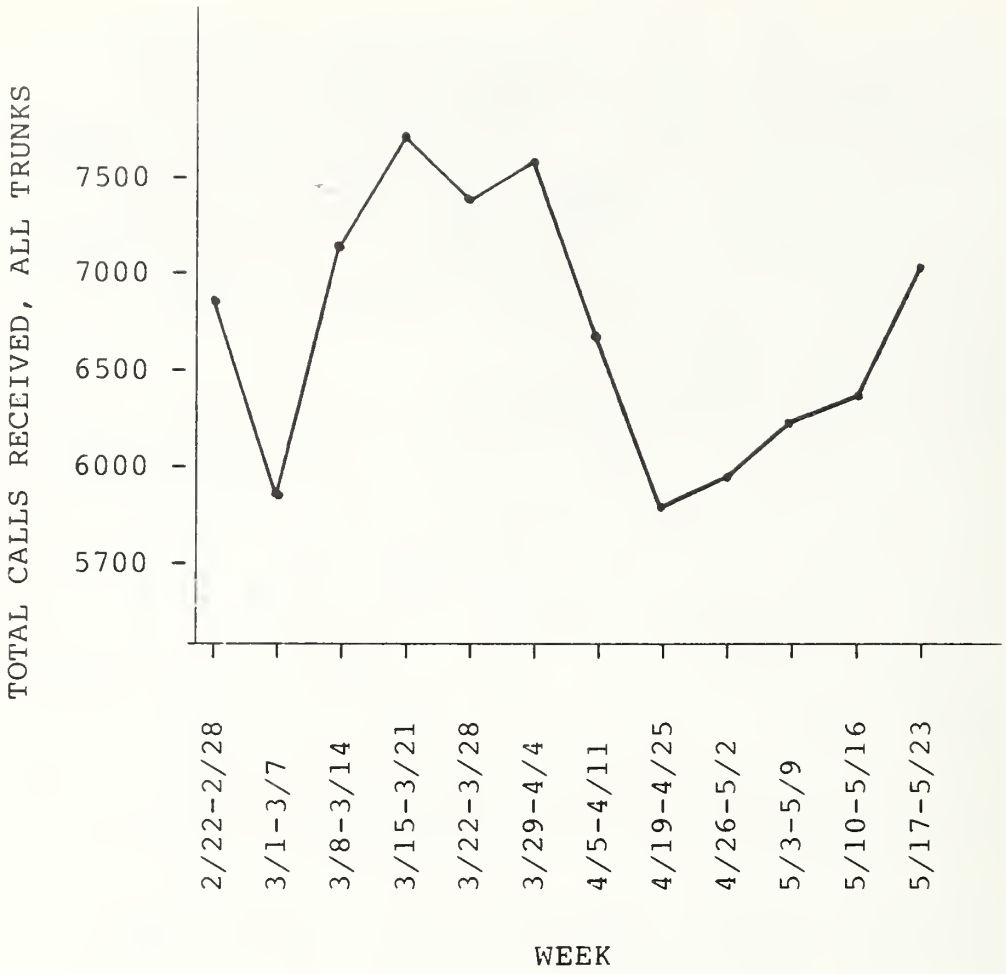

FIGURE 3-1. TOTAL DAILY CALLS RECEIVED
BY TELEPHONE INFORMATION SECTION:
AVERAGE FOR EACH WEEK OF THE TEST PERIOD
(6am -- 5 pm)

Source: ACD Trunk Group Readings

received on the Van Nuys Trunk during the 6 am to 5 pm time period ranged from a low of 560 on March 22 to a high of 1549 on April 14. The average number of calls received on this trunk between 6 am and 5 pm was 972; the standard deviation was 200.

As in Figure 3-1, total calls received on the Van Nuys trunk were averaged for each week of the test period; the results are shown in Figure 3-2. From Figure 3-2, it can be seen that the weekly patterns of Van Nuys caller demand are quite independent of those for the entire facility. The correlation coefficient r^2 between the two demand distributions is only .31, indicating very low correlation between them. Unlike the pattern shown in Figure 3-1, Van Nuys demand was relatively low for the first 6 weeks of the test period, averaging approximately 903 calls per day. For the last 7 weeks of the test period, however, Van Nuys demand increased considerably, especially during the weeks of April 12-18 and May 10-16. The average daily demand on the Van Nuys trunk for these last 7 weeks was 1030 calls.

Figure 3-3 presents the result obtained when the average daily van Nuys demand is divided into average daily total demand for each week of the test period. Figure 3-3 thus represents the average daily market share of the Van Nuys trunk for each week of the test period. As can be seen from Figure, 3-3 the Van Nuys trunk accounted for slightly under 15% of all calls on average during the test period. The average Van Nuys trunk market share fluctuated from a low of 11.3% of all calls during the week of March 29 - April 4 to a high of 19.7% during the week of April 12 - 18. The first 6 weeks of the test period were characterized by a relatively low (12.8%) Van Nuys market share. During the final 7 weeks of the test period, the Van Nuys share rose appreciably to 16.3% of all calls.

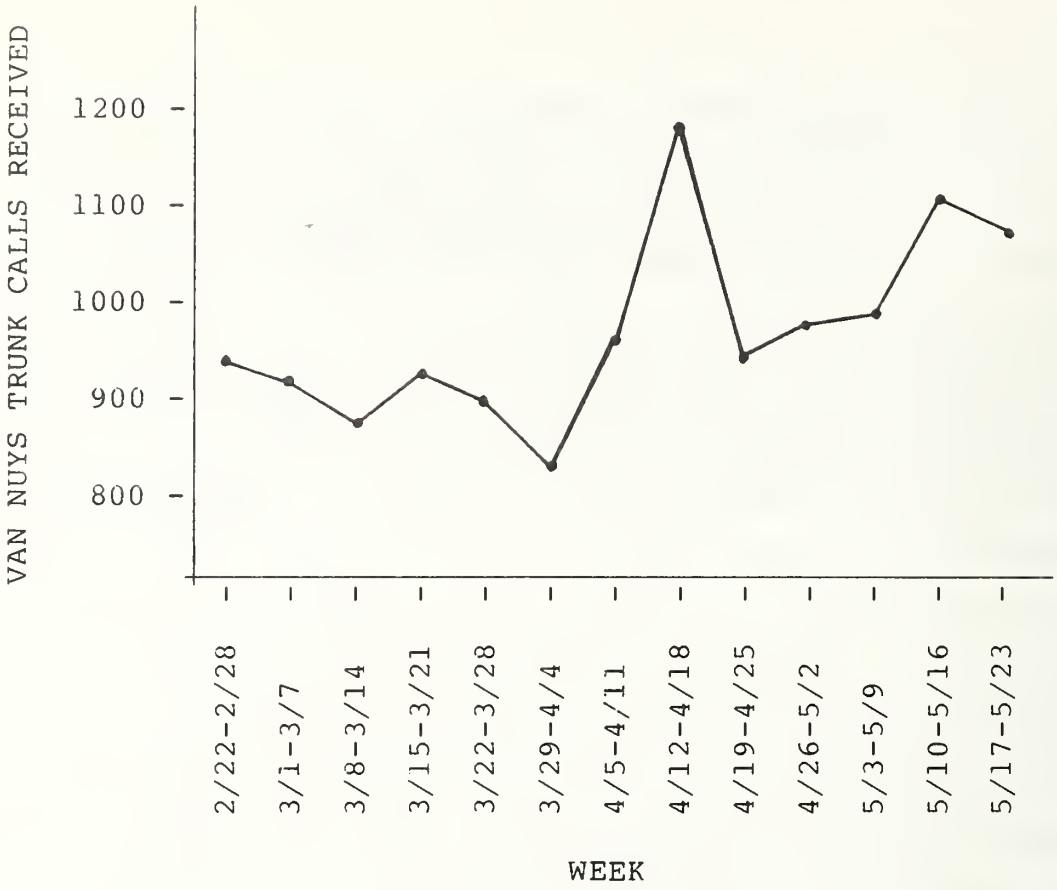

FIGURE 3-2. TOTAL DAILY CALLS RECEIVED,
VAN NUYS (CCIS) TRUNK AVERAGE FOR EACH WEEK
OF THE TEST PERIOD
(6 am -- 5 pm)

Source: ACD Trunk Group Readings

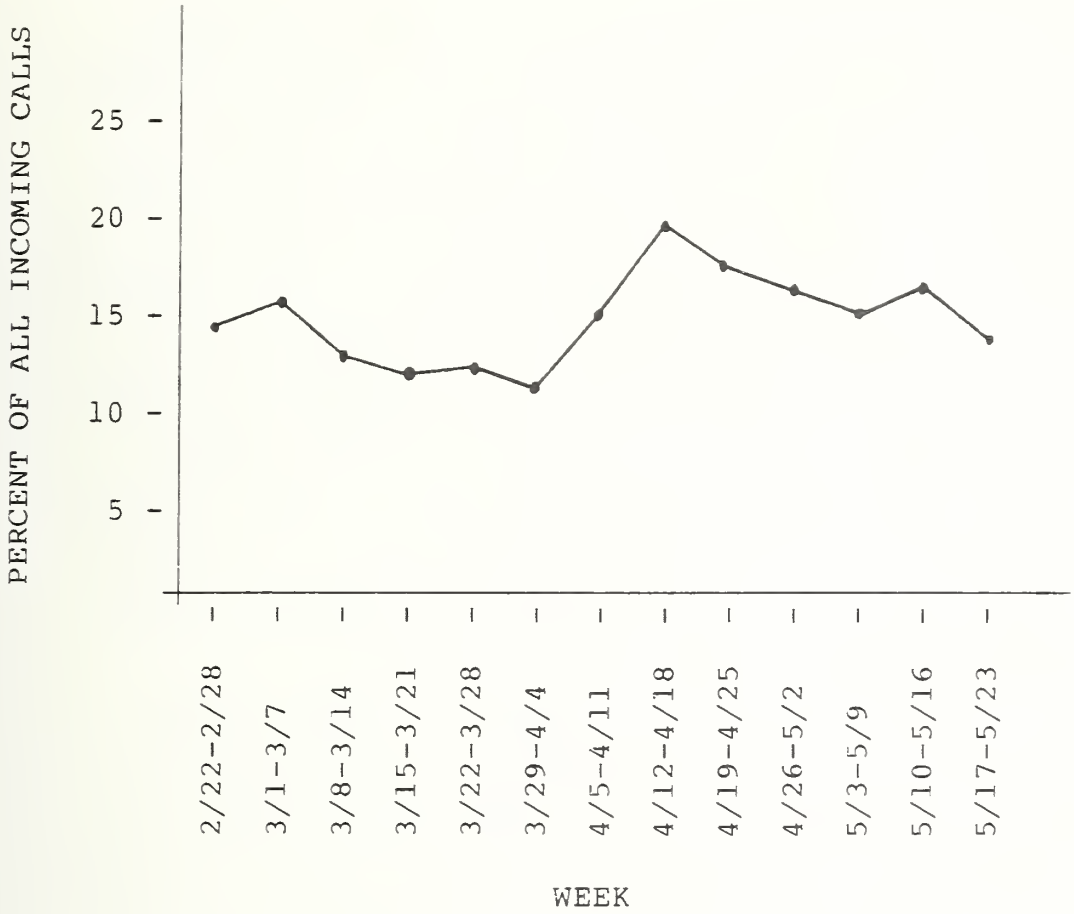

FIGURE 3-3. DAILY MARKET SHARE OF VAN NUYS (CCIS) TRUNK: AVERAGE FOR EACH WEEK OF THE TEST PERIOD
(6 am -- 5 pm)

Source: ACD Trunk Group Readings

Figures 3-4 and 3-5 show results obtained by averaging total calls received and Van Nuys trunk calls received between 6 am and 5 pm by day of the week over the entire period. The patterns shown on Figures 3-4 and 3-5 are similar; they show that caller demands exhibit a high degree of fluctuation during the week, a fact that has strong implications on scheduling of Information Section staffing. In both figures, Sunday demand is the lowest for any day of the week, approximately 70% of average daily demand. From this low point, demand peaks on Monday and Tuesday at approximately 113% of average demand. From Tuesday through Saturday, demand declines almost linearly (Van Nuys demand exhibits a sub-peak on Fridays). Saturday demands in both cases are approximately 90% of average daily demand.

In Figures 3-6 and 3-7, hourly demand patterns for all incoming calls and for Van Nuys trunk calls are presented. These patterns were derived by averaging hourly readings for each Monday of the test period. Mondays were chosen for this hourly analysis since they are generally the peak demand day of the week. The two figures show similar patterns for the Van Nuys trunk and the total operation. In the morning hours, incoming calls build from a low point of approximately 30% of average hourly demand at 6 am to peak of 150% of average hourly demand between 10 and 11 am. From this point on, demand gradually tapers off to nearly the average hourly rate by 6 pm.

3.3.2 Characteristics of System Productivity

Of prime concern in evaluation of CCIS is the number of calls which are actually answered by information agents. As noted previously, a substantial proportion of callers, especially during peak demand periods, hand up before reaching an information agent. Since the ACD system records these "lost" calls, and since calls answered by CCIS agents are recorded on the

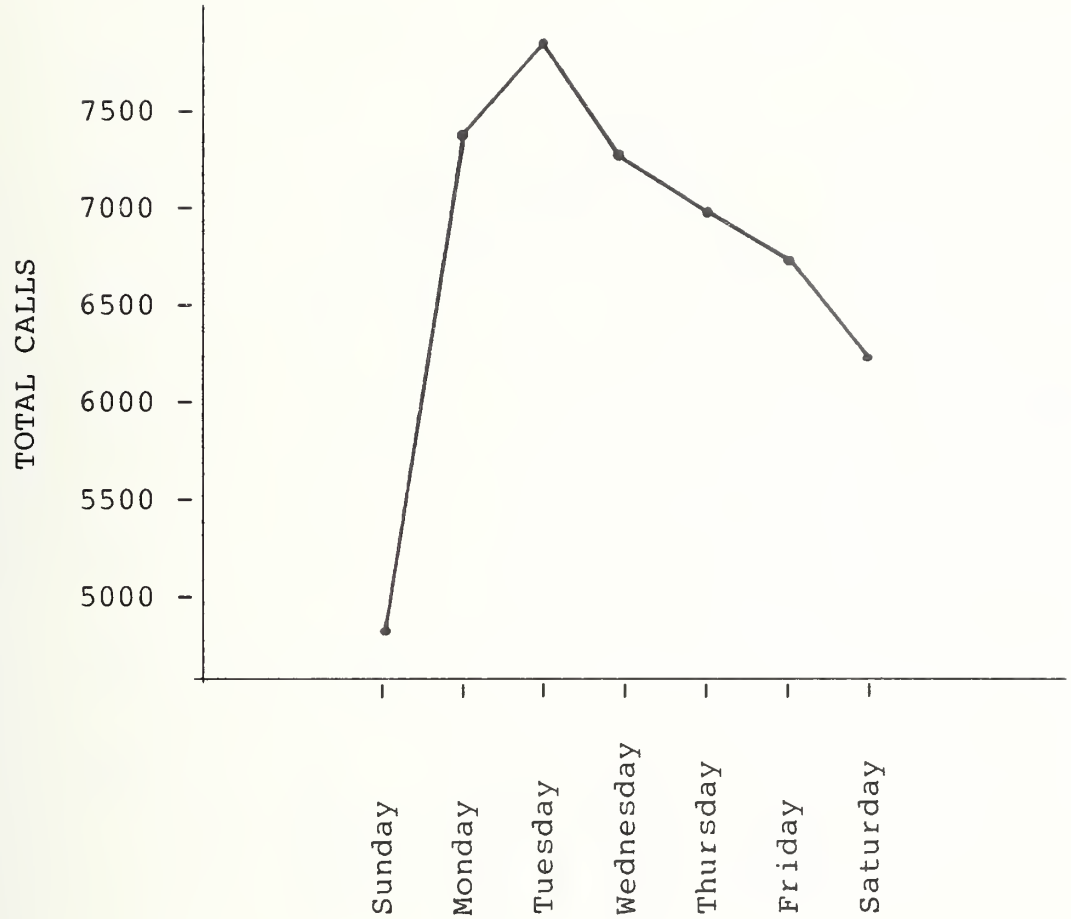

FIGURE 3-4. TOTAL CALLS RECEIVED, ALL TRUNKS,
BY DAY OF WEEK (6 am - 5 pm)
AVERAGE FOR ENTIRE TEST PERIOD

Source: ACD Trunk Group Readings

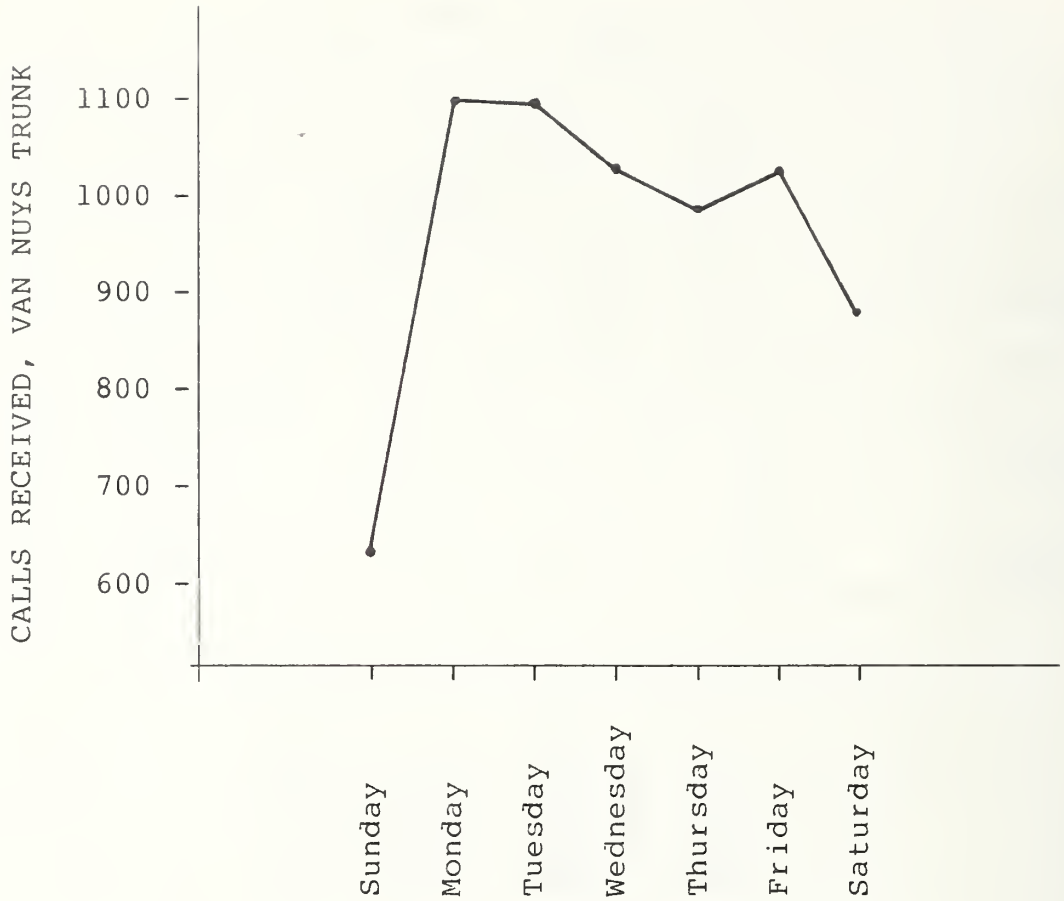

FIGURE 3-5. TOTAL DAILY CALLS RECEIVED,
VAN NUYS (CCIS) TRUNK,
BY DAY OF WEEK (6 am - 5 pm)
AVERAGE FOR ENTIRE TEST PERIOD

Source: ACD Trunk Group Readings

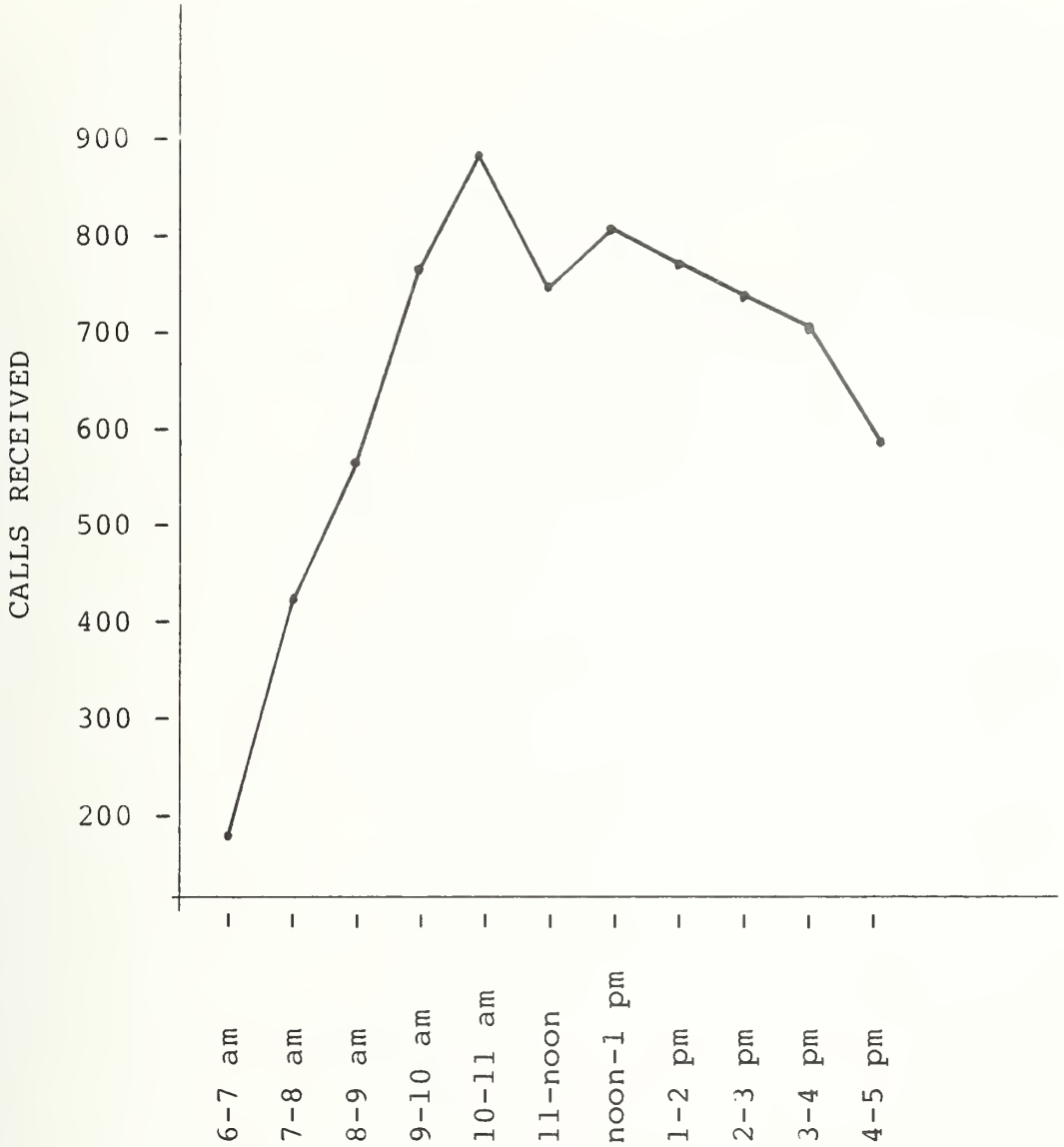

FIGURE 3-6. TOTAL CALLS RECEIVED, ALL TRUNKS,
BY HOUR OF DAY, MONDAYS ONLY
AVERAGE FOR ENTIRE TEST PERIOD

Source: ACD Trunk Group Readings

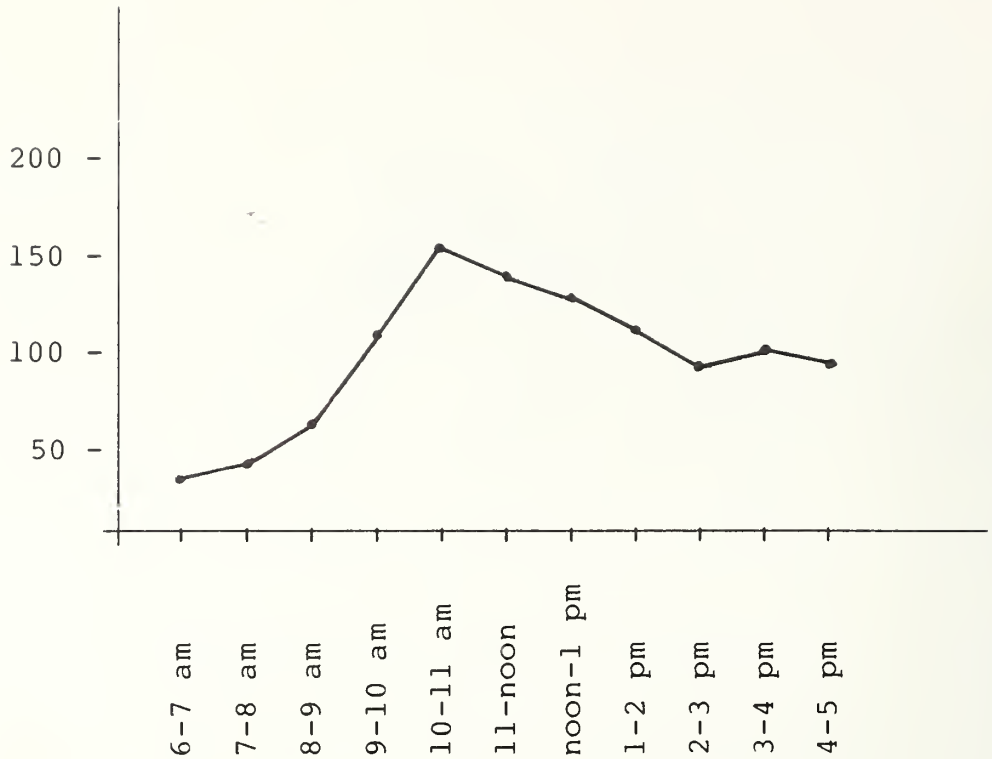

FIGURE 3-7. TOTAL CALLS RECEIVED,
VAN NUYS (CCIS) TRUNK,
BY HOUR OF DAY, MONDAYS ONLY
AVERAGE FOR ENTIRE TEST PERIOD

Source: ACD Trunk Group Readings

CCIS log file, it is possible to make an important comparison between the overall productivities, in terms of calls answered and calls lost, of manual and CCIS agents.

In Figures 3-8 and 3-9, average daily calls answered by CCIS (Van Nuys) and manual (non-Van Nuys) agents are presented. The points plotted in these graphs were derived by subtracting the CCIS log file average daily call counts from the average daily calls answered for the Van Nuys trunk and the entire Information Section for each week of the test period. Figure 3-8 shows that CCIS agents answered an average of 570 calls daily between 6 am and 5 pm during the test period. Figure 3-9 shows that the 25 to 30 manual agents on duty from 6 am to 5 pm each day answered an average of approximately 3550 calls.

Figure 3-10 presents a comparison of CCIS versus manual agent productivity; namely, the percentage obtained when answered calls (obtained from CCIS log file call counts) for each group of agents are divided into total calls received (obtained from the ACD Trunk Group Readings). Average daily statistics for each week of the test period, as shown in Figures 3-2 and 3-9, were used in this calculation. Over the test period, CCIS agents answered approximately 59% of all Van Nuys calls. Their trend, as shown in the solid line Figure 3-10, indicates CCIS agents were generally more productive over the first six weeks of the test period, during which time the average daily calls answered approximated 63% of all calls received. In the last 6 weeks of the test period for which log file data exists (as noted earlier, the week of April 26 to May 2 was missing), calls answered by CCIS agents approximated only 55% of calls received. The maximum observed CCIS productivity occurred during the week of March 15 - 21, in which 66% of all Van Nuys calls were answered; the minimum occurred during the week of May 10 - 16, in which only 49% of Van Nuys calls were answered. The dotted line in Figure 3-10 presents productivity statistics derived in a similar fashion for manual (non-Van Nuys) agent productivity. The points plotted in this dotted line show that

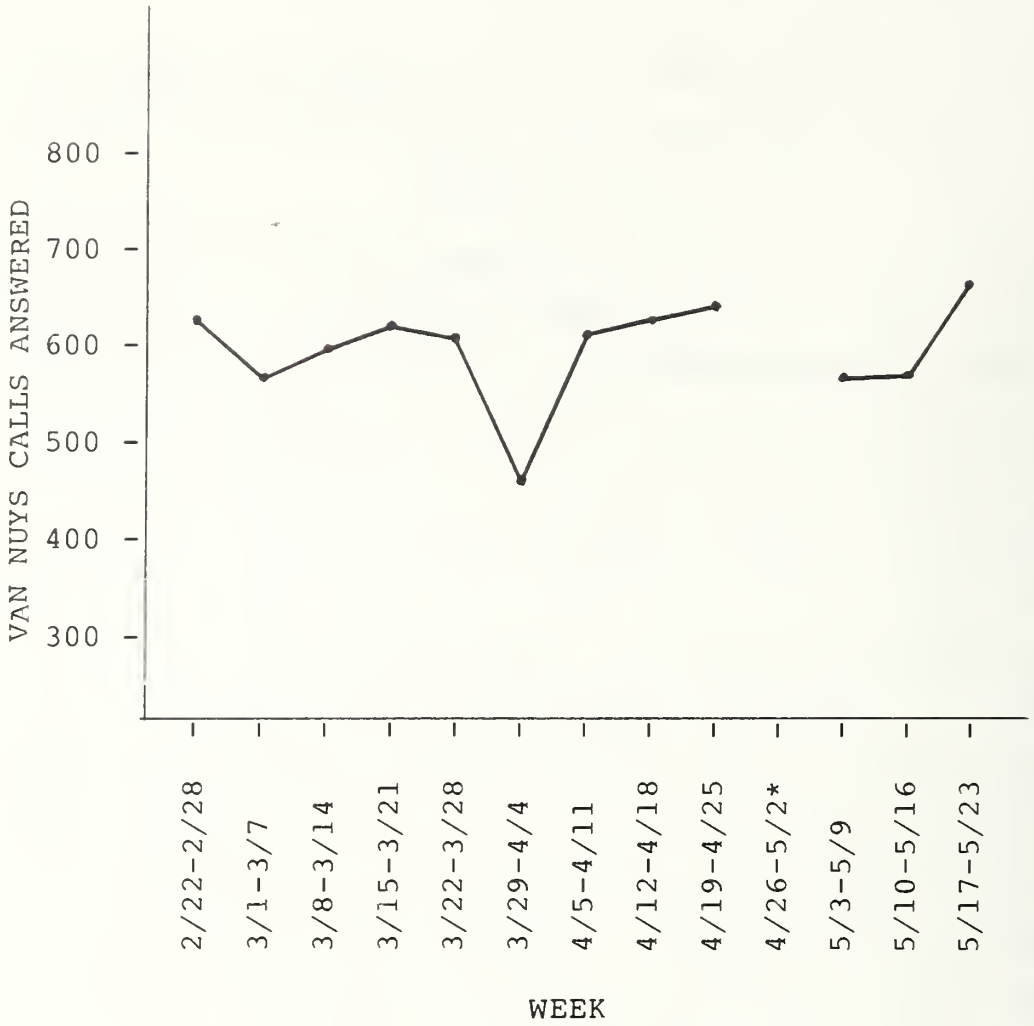

FIGURE 3-8. DAILY VAN NUYS TRUNK CALLS ANSWERED: AVERAGE FOR EACH WEEK OF THE TEST PERIOD

Source: CCIS Log File
* Missing from CCIS Log File

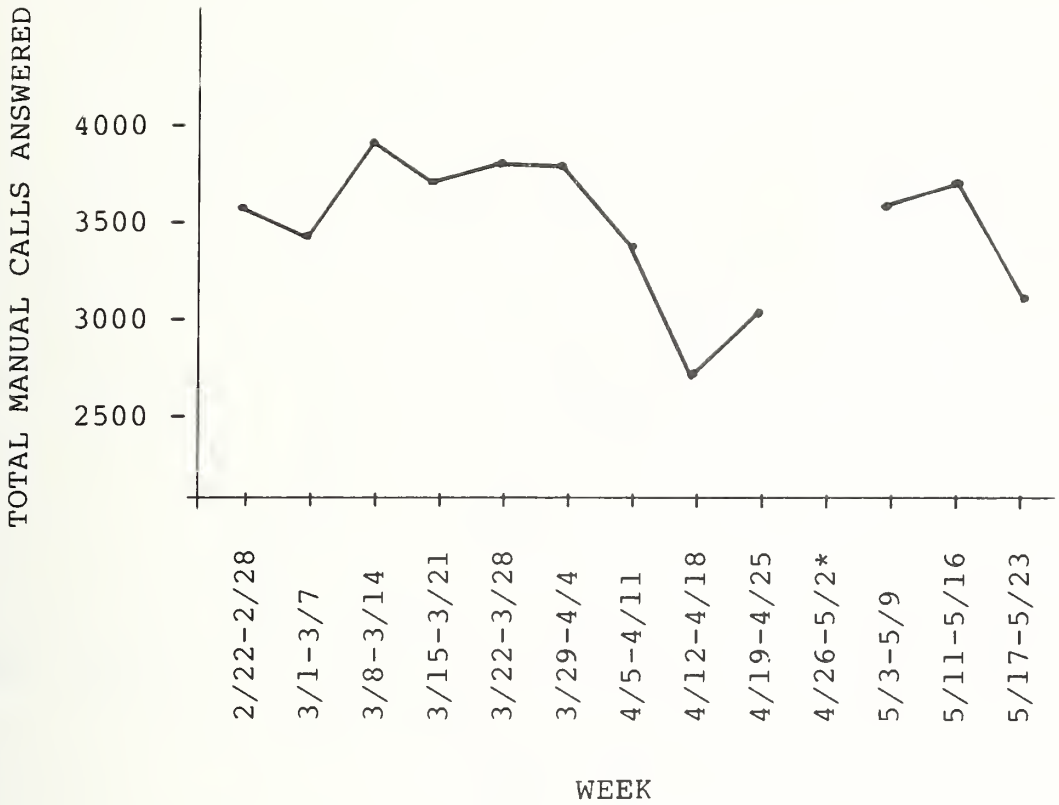

FIGURE 3-9. TOTAL DAILY CALLS ANSWERED BY MANUAL (NON-VAN NUYS) AGENTS AVERAGE FOR EACH WEEK OF TEST PERIOD

Source: ACD Trunk Group Readings
* Missing from CCIS Log File Data

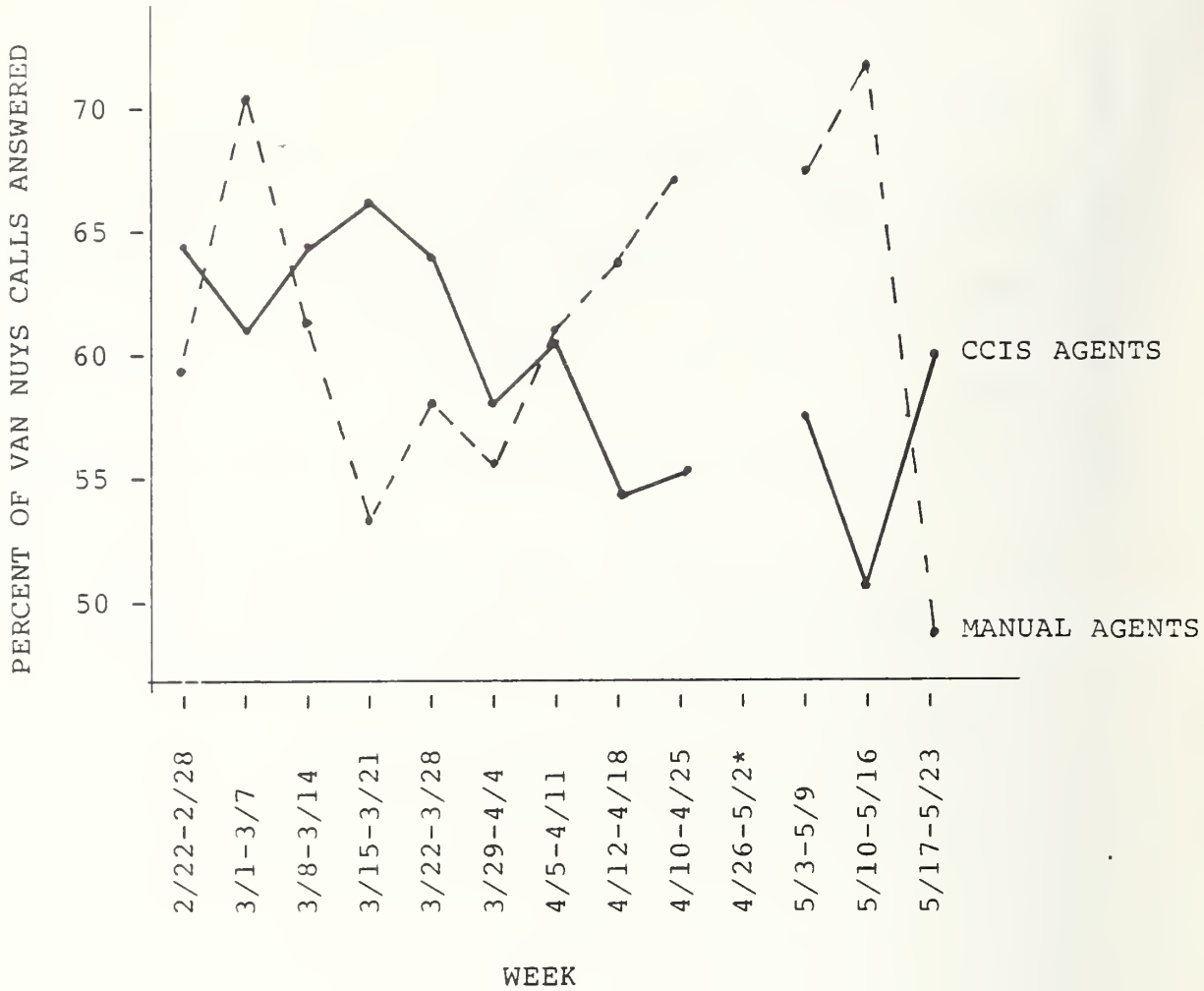

FIGURE 3-10. DAILY PERCENTAGE OF ALL VAN NUYS TRUNK CALLS ANSWERED BY CCIS AGENTS (SOLID LINE) AND NON-VAN NUYS TRUNK CALLS ANSWERED BY MANUAL AGENTS (DOTTED LINE): AVERAGE FOR EACH WEEK OF THE TEST PERIOD

Source: ACD Trunk Group Readings

* Missing from CCIS Log File

manual agent productivity, in terms of calls answered, was quite variable from week to week, ranging from 54% of all calls answered in the week of May 17-23, to almost 71% of such calls in the week of May 10-16. The average share of non-Van Nuys calls answered by manual agents over the entire test period was approximately 61%.

Comparison of the solid (CCIS) and dotted (manual) lines in Figure 3-10 leads to two interesting conclusions. The first conclusion is the rather important fact that implementation of the CCIS has not, based on these data, created an appreciable increase over manual methods in the overall percentage of calls answered during the test period. The CCIS agents answered a higher percentage of calls received via the Van Nuys trunk than did manual agents on their respective trunks for 5 of the first 6 weeks in the test period. Conversely, the CCIS agents answered a lesser percentage in all but the final of the last 7 weeks. The overall percentages of calls answered by both groups over the entire test period, however, are quite comparable: 59% for the CCIS agents versus 61% for the manual agents.

The second conclusion that can be drawn from comparing the two agent productivity lines on Figure 3-10 is that CCIS productivity in terms of daily answered calls for some reason exhibits an inverse relationship to that for manual agents. In 9 out of the 12 weeks for which this comparison was possible, CCIS agent productivity increased while manual agent productivity decreased, or vice versa. During the weeks of April 5-11 and April 19-25, productivity for both groups increased, while they both declined during the week of March 29 - April 4.

Several caveats to the above productivity comparison between CCIS and manual agents should be considered. The first caveat is that caller demands for both CCIS and manual services originated from different locations in a large metropolitan area, and these demands (type and length of caller queries, for example) might be quite different, requiring

different types of agent responses and taking different lengths of time.

A second caveat is that Information Section staffing, in terms of agents on duty per call received, varies throughout the course of the day, and may well have been quite different for CCIS and manual agents for some or all of the test period in terms of number of available agents per hourly caller demand. Since daily staffing data were not available, derivation of true productivity comparisons between manual and CCIS agents (in terms of calls answered per man-hour worked) were not possible.

A third caveat, as explained above, is that CCIS agents were occasionally confronted with situations in which they were forced to re sort to manual data retrieval. Thus, no productivity comparison between the two groups is completely unbiased.

A final caveat to the above comparison is that the number of lost calls for the CCIS and manual groups might be a function of variables other than agent productivity. For example, callers averse to waiting "on hold" for an agent might hang up immediately after hearing the recorded message of the ACD system, even in situations where productivity was quite high and the caller holding period was very brief. Thus, basing agent productivity comparisons completely on the overall percentage of calls answered might not be totally valid.

3.3.3 Detailed Characteristics of CCIS Calls

In Figures 3-11 through 3-17, a variety of detailed data concerning CCIS agent performance as compiled by the CCIS log file are presented. As noted previously, these data apply only to those calls answered by CCIS agents using CCIS equipment.

Figure 3-11 displays the average duration of each CCIS call for each week of the test period. These call times, together with their respective standard deviations, are also presented in Table 3-2. It is clearly evident from these data that there

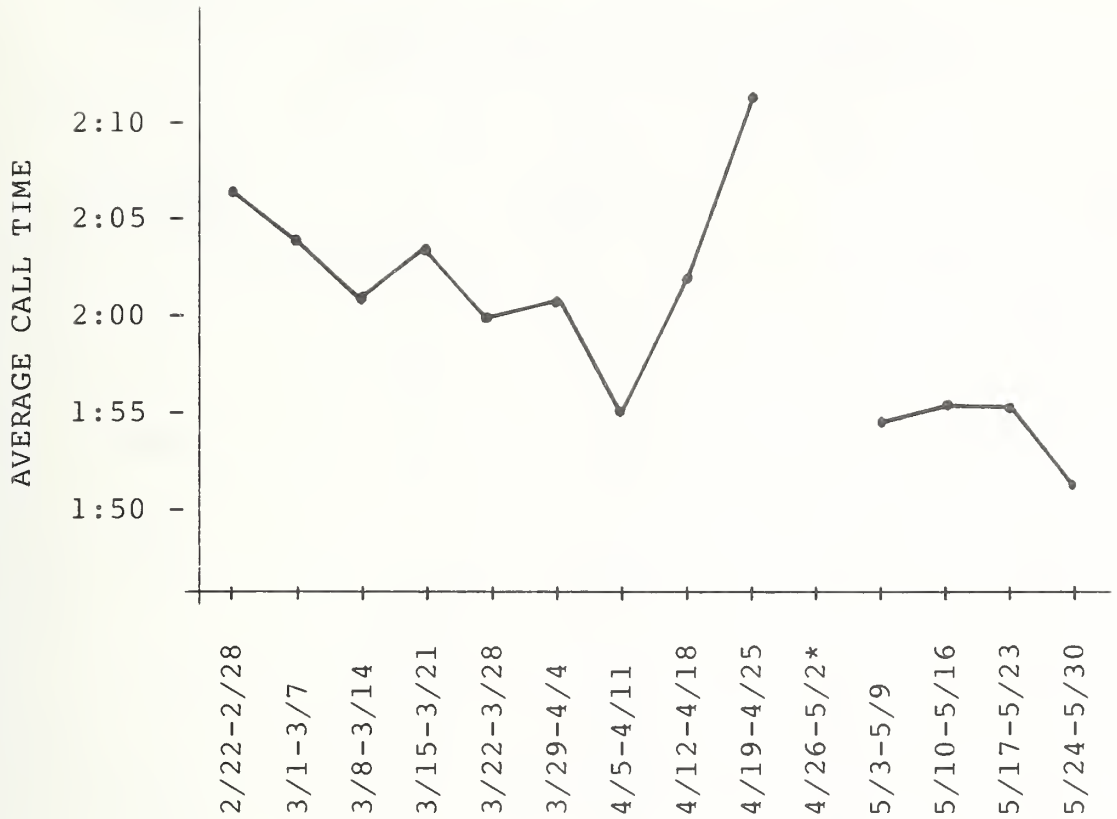

FIGURE 3-11. AVERAGE CALL TIMES, CCIS CALLS ANSWERED, FOR EACH WEEK OF THE TEST PERIOD

SOURCE: CCIS Log File
* Missing from CCIS Log File

TABLE 3-2. AVERAGE CALL TIMES AND STANDARD DEVIATIONS FOR EACH WEEK OF THE TEST PERIOD

WEEK	AVERAGE CALL TIME	STANDARD DEVIATION
2/22 - 2/28	2:09	1:26
3/1 - 3/7	2:05	1:23
3/8 - 3/14	2:02	1:24
3/15 - 3/21	2:04	1:21
3/22 - 3/28	2:01	1:22
3/29 - 4/4	2:02	1:22
4/5 - 4/11	1:55	1:16
4/12 - 4/18	2:03	1:25
4/19 - 4/25	2:11	1:31
4/26 - 5/2*	*	*
5/3 - 5/9	1:55	1:20
5/10 - 5/16	1:56	1:28
5/17 - 5/23	1:56	1:18
5/23 - 5/30	1:53	1:15

* Missing from CCIS Log File

Source: CCIS Log File

was a pronounced downward trend in CCIS call times over the course of the test period, with the exception of a two-week period in April in which call times and standard deviations both rose substantially (April 12-25). Call times ranged from a high of 2:11 during the week of April 19-25 to a low of 1:53 during the week of May 24-30. The average call time for the entire test period was 2:01.

The statistics presented in Figure 3-12 are those derived when the call times of Figure 3-11 are divided into 3600, the number of seconds per hour. The result is the average "projected" number of CCIS calls per hour answered for each week of the test period. The hourly call count is the SCRTD's chief measure of agent productivity. SCRTD agent training focuses on techniques for increasing hourly call counts; agents at the end of their training period are expected to answer at least 20 calls per hour. The "projected" call count, of course, rather unrealistically assumes no agent "break" time between calls. As can be seen from Figure 3-12, CCIS projected hourly call counts exceed the SCRTD standard substantially, even for those weeks in which call times were longest. The average projected hourly call count for the entire test period was approximately 29.9, 49.3% higher than the SCRTD standard.

By pressing a "release" button on the telephone console, it is possible for an agent to interrupt the routing of the next call to his or her work station, thus allowing a break from the routine. The large discrepancy between actual call counts (20 per hour) and "projected" call counts (30 per hour) suggests that agents might have been abusing this release mechanism during the system evaluation period. In late 1981, when new telephone equipment was installed, SCRTD management was able for the first time to monitor and control the extent to which each agent used the release. A maximum of 12 minutes of break time per 8-hour shift was established, and average agent call counts increased considerably to approximately 25 per hour.

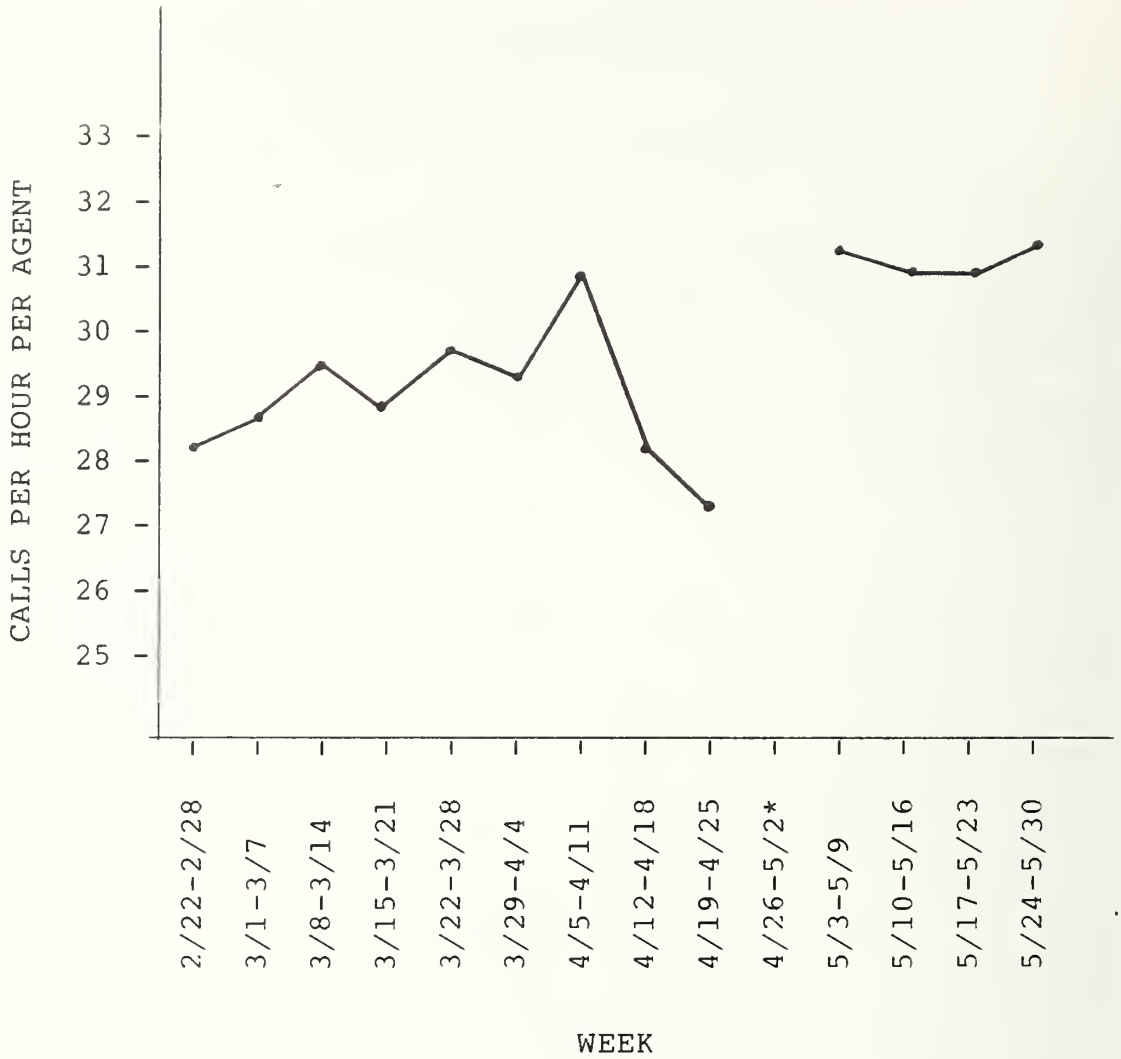

FIGURE 3-12. PROJECTED CCIS CALLS PER HOUR PER AGENT AVERAGE FOR EACH WEEK OF THE TEST PERIOD

SOURCE: CCIS Log File
* Missing from CCIS Log File

Figure 3-13 presents a variable of considerable interest to the evaluation. The percentage of CCIS calls (averaged for each week of the test period) which were answered "manually;" that is, those for which no CCIS transactions were undertaken. Such calls could be of two different types. They could be those in which the customer's origin or destination fell outside the CCIS geographic data base, or those in which the agent knew the answer to the caller's query without recourse to any data sources. The first type of "manual" call would require an agent to retrieve data from printed materials, and would presumably take longer than the average CCIS-assisted call. The second type would require no retrieval, and would presumably be shorter than the average CCIS call. During the test period, it is evident from data collected in the CCIS log file that the preponderance of these "manual" calls were of the second type, as average manual call times reported are almost invariably faster than CCIS call times. On average over the entire test period, they average approximately 25 seconds faster than CCIS calls. The percentage of these manual calls on the CCIS remained fairly constant over the test period, averaging about 24% of all CCIS calls answered. The highest percentage occurred during the first week of the test period, February 22-28, when 29.6% of all calls were answered manually. The lowest observed percentage occurred the following week, March 1-7, when 19.9% of all calls were handled manually.

Table 3-3 and Figure 3-14 present a breakdown of all CCIS calls classified by duration of call, as averaged for each week of the test period. These data show that the percentage of calls answered in less than one minute remained relatively constant, increasing slightly towards the end of the test period. The percentage of calls answered in less than 1 minute during the test period ranged from 18.4 in the week of March 1-7 to 25.3 in the week of May 24-30, with an average value of 20.0.

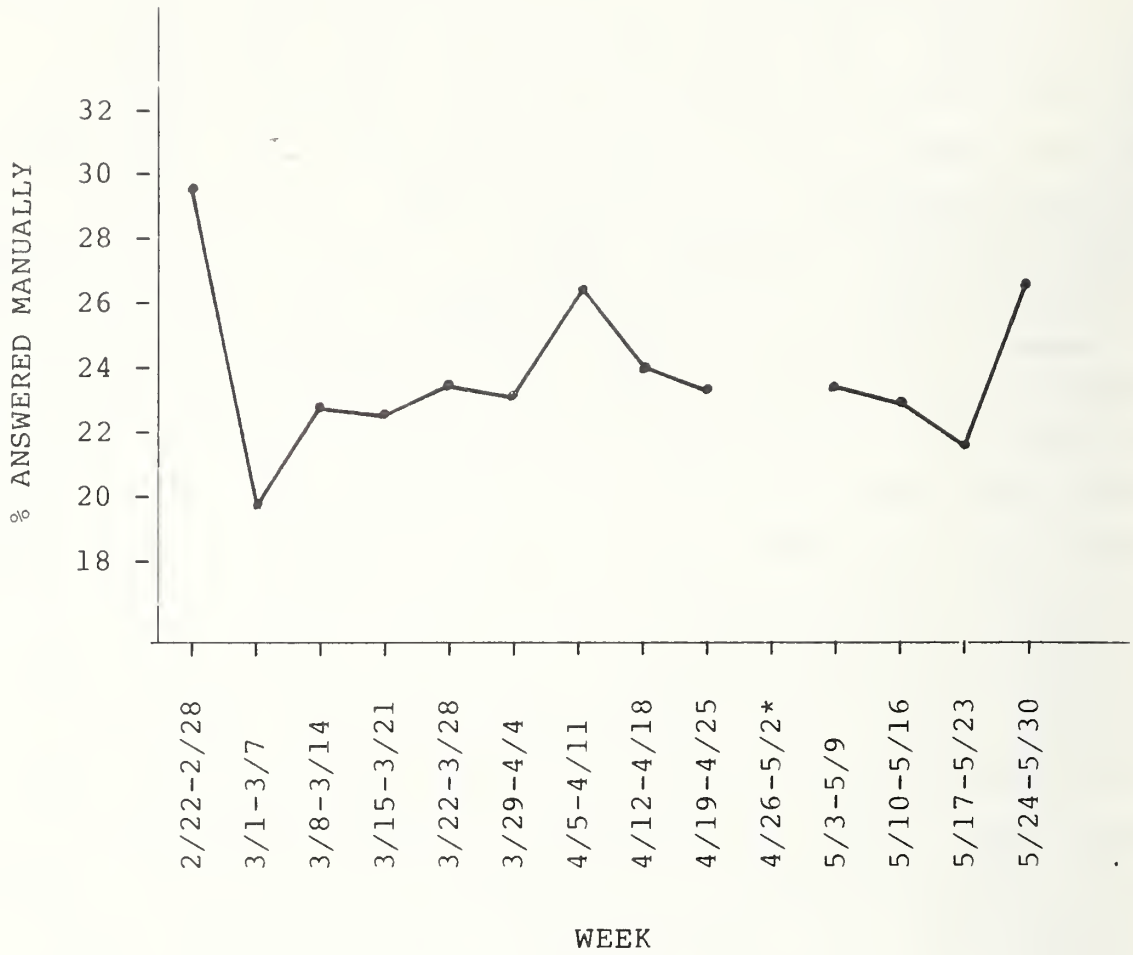

FIGURE 3-13. PERCENT OF CCIS CALLS ANSWERED MANUALLY
(NO SYSTEM TRANSACTIONS)
AVERAGE FOR EACH WEEK OF THE TEST PERIOD

Source: CCIS Log File
* Missing from CCIS Log File Data

TABLE 3-3. CLASSIFICATION OF CCIS CALLS ANSWERED BY DURATION OF CALL

WEEK	LESS THAN ONE MINUTE	LESS THAN TWO MINUTES	LESS THAN THREE MINUTES	OVER THREE MINUTES
2/22-2/28	21.6	57.9	78.5	21.5
3/1-3/7	18.4	59.3	79.9	20.1
3/8-3/14	21.3	60.4	81.4	18.6
3/15-3/21	21.5	58.1	79.7	20.3
3/22-3/28	20.9	60.2	82.9	18.1
3/29-4/4	21.3	60.3	79.8	20.2
4/5-4/11	23.5	62.7	84.0	16.0
4/12-4/18	21.5	60.8	81.0	19.0
4/19-4/25	18.9	57.4	78.4	21.6
4/26-5/2*	*	*	*	*
5/3-5/9	24.7	63.9	83.9	16.1
5/10-5/16	24.2	63.2	84.1	16.0
5/17-5/23	23.4	62.5	83.0	17.0
5/24-5/30	25.3	64.5	83.8	16.2
AVERAGE	22.0	60.9	81.5	18.5

* Missing from CCIS Log File Data

Source: CCIS Log File

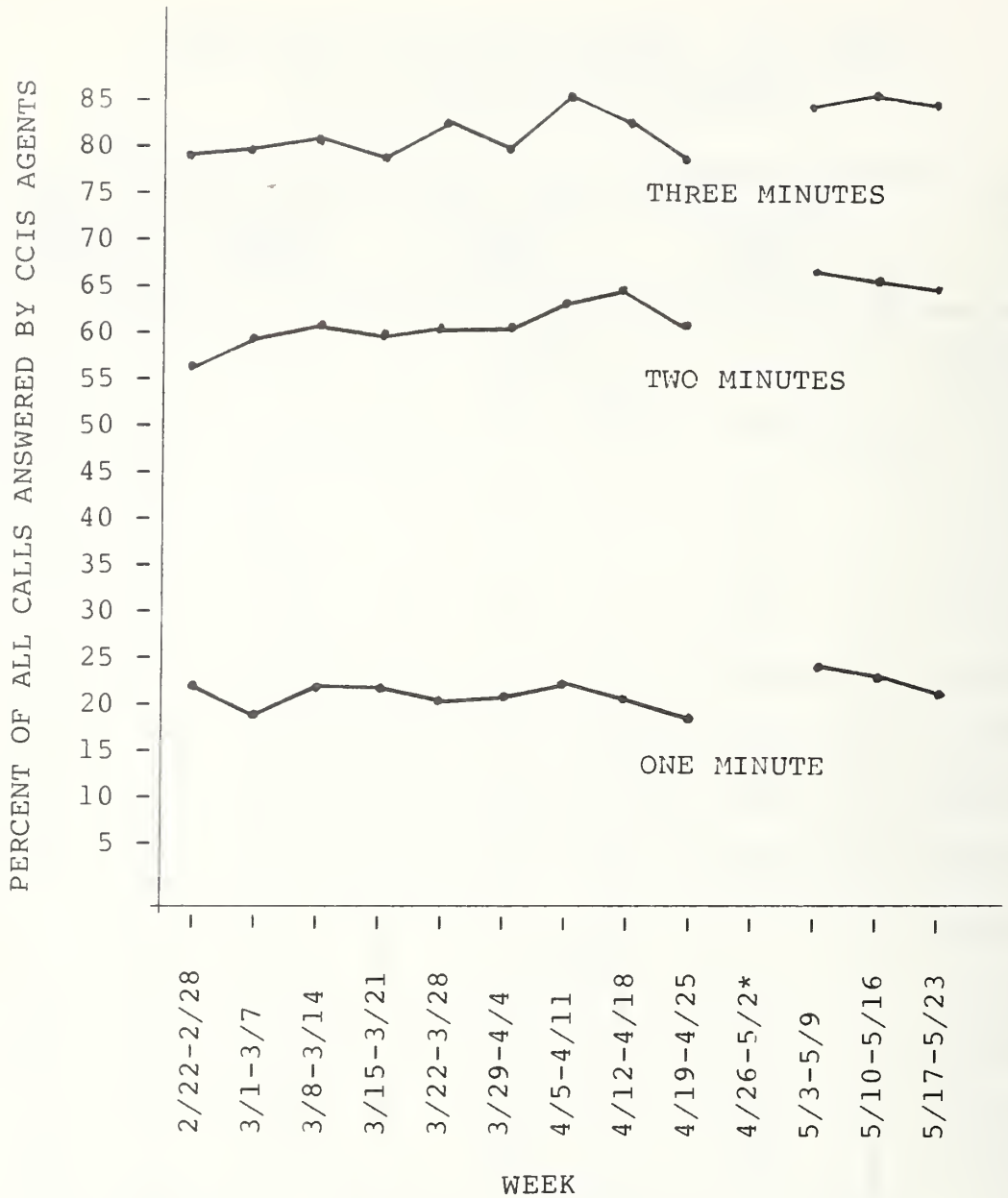

FIGURE 3-14. PERCENTAGES OF CCIS CALLS ANSWERED HAVING DURATIONS OF ONE, TWO, OR THREE MINUTES OR LESS AVERAGES FOR EACH WEEK OF THE TEST PERIOD

Source: CCIS Log File
* Missing from CCIS Log File Data

Calls answered in two minutes or less show a gradual upward trend through the test period with the exception of the two-week period from April 11-25. The percentage of 2-minute duration calls ranged from 57.4 in the week of April 19-25 to 64.5 in the week of May 24-30, with an average value for the test period of 60.9. Calls answered in 3 minutes or less (the SCRTD standard of 20 calls per hour) also exhibit an upward trend throughout the test period, ranging from 78.4 percent of all calls during the week of April 19-25 to 84.1 percent of all calls during the week of May 10-16. The average percentage of calls answered in 3 minutes or less for the entire test period was 81.5. Conversely, the average percentage of calls taking longer than 3 minutes to complete was 18.5.

Figure 3-15 presents a plot of CCIS user errors per call answered averaged for each week over the test period. The CCIS actually kept track of three different types of errors: CCIS internal (software) errors, input-output (hardware) errors, and user errors. Errors of the first two types were extremely infrequent, occurring on less than five occasions during the entire test period. User errors which include typing, spelling and other data entry errors were more frequent, ranging from one error in every 3.57 calls in the first week of the test period (February 22-28) to one error in every 6.67 calls in the final week (May 24-30). Over the entire period, CCIS agents averaged one error every 5 calls. The points plotted in Figure 3-15 show a generally decreasing trend in user errors per call with the exception of the two-week period from April 11-25.

The CCIS was able to measure and record times for various segments of each CCIS call. Calls can be divided into three separate components: the caller query, the machine interaction (agent keyboard input, machine transaction processing and response screen display), and agent response. Average durations for each of these call segments for each week of the test

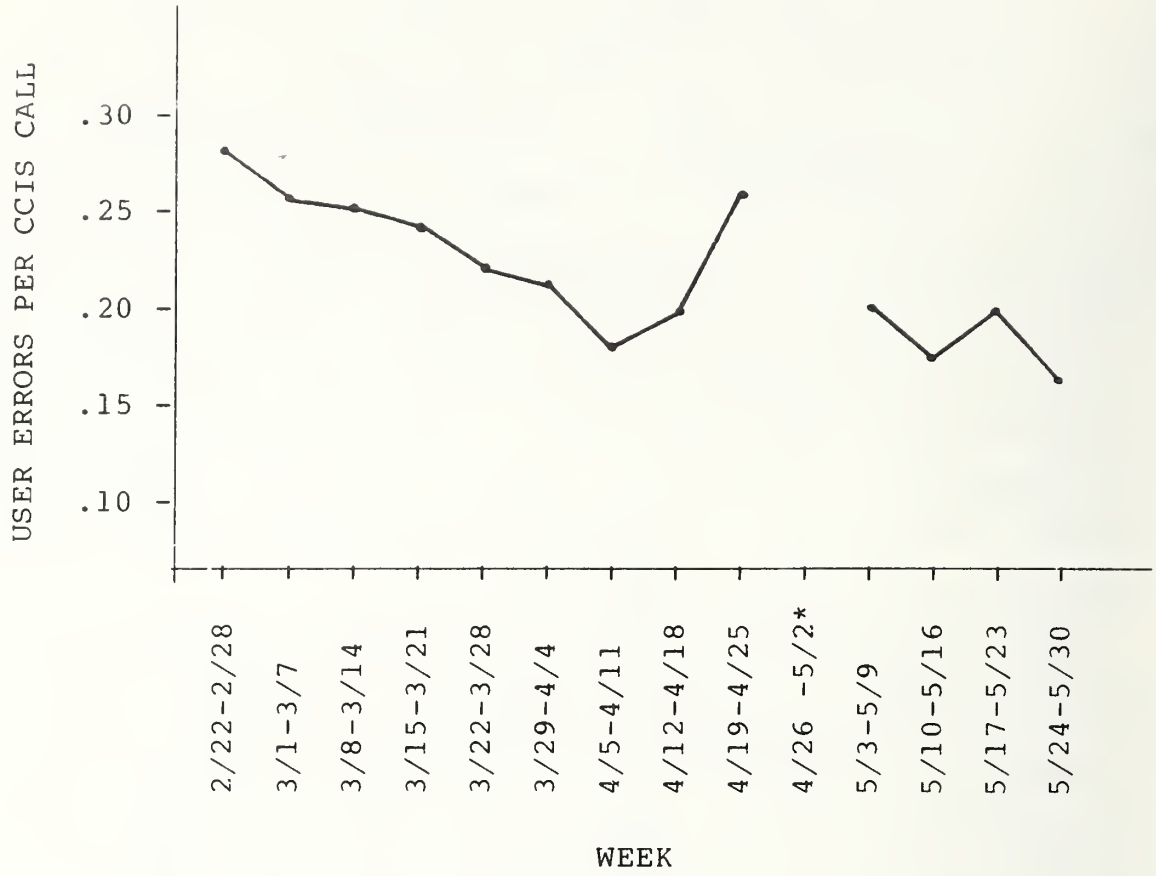

FIGURE 3-15. USER ERRORS DETECTED BY CCIS
PER CALL ANSWERED
AVERAGE FOR EACH WEEK OF TEST PERIOD

Source: CCIS Log File
* Missing from CCIS Log File Data

period are presented in Figure 3-16, and tabulated in Table 3-4. From these data, it can be seen that machine interaction and agent response times remained quite stable over the course of the test period, averaging 24 and 49 seconds, respectively. Only during the two-week period of April 12-25 were three major fluctuations in durations for these two call segments. Average durations of caller queries, on the other hand, show a pronounced downward trend over the test period, with the exception of April 19-25.

Figure 3-17 portrays a further breakdown of the machine interaction call segment shown in Figure 3-16. This segment can be divided into two parts: first, the amount of time spent by the agent entering appropriate information on the terminal keyboard, and second, the amount of time spent by the computer in retrieving and displaying the appropriate response. As can be seen in Figure 3-17, actual retrieval time takes a small fraction of total machine interaction time (an average of 14% for the entire test period). Retrieval took an average of only 3% of total call time. Over the test period, 96.3% of all machine responses were given in 7 seconds or less, the performance standard originally specified by the SCRTD.

3.4 CCIS CONTROLLED EXPERIMENT RESULTS

The CCIS controlled experiment conducted by the evaluation contractor produced separate call times for each test agent and each test question. For all 9 test agents, the average call time for all test agents was slightly over four minutes per call. Table 3-5 presents average agent call times for each of the 4 nine-question sections of the test broken down by agent skill/experience level. The test was broken down into 4 sections in order to reduce the number of participants (and tests) required for analysis of variance results to be obtained. As might be expected, the novice agents took longer

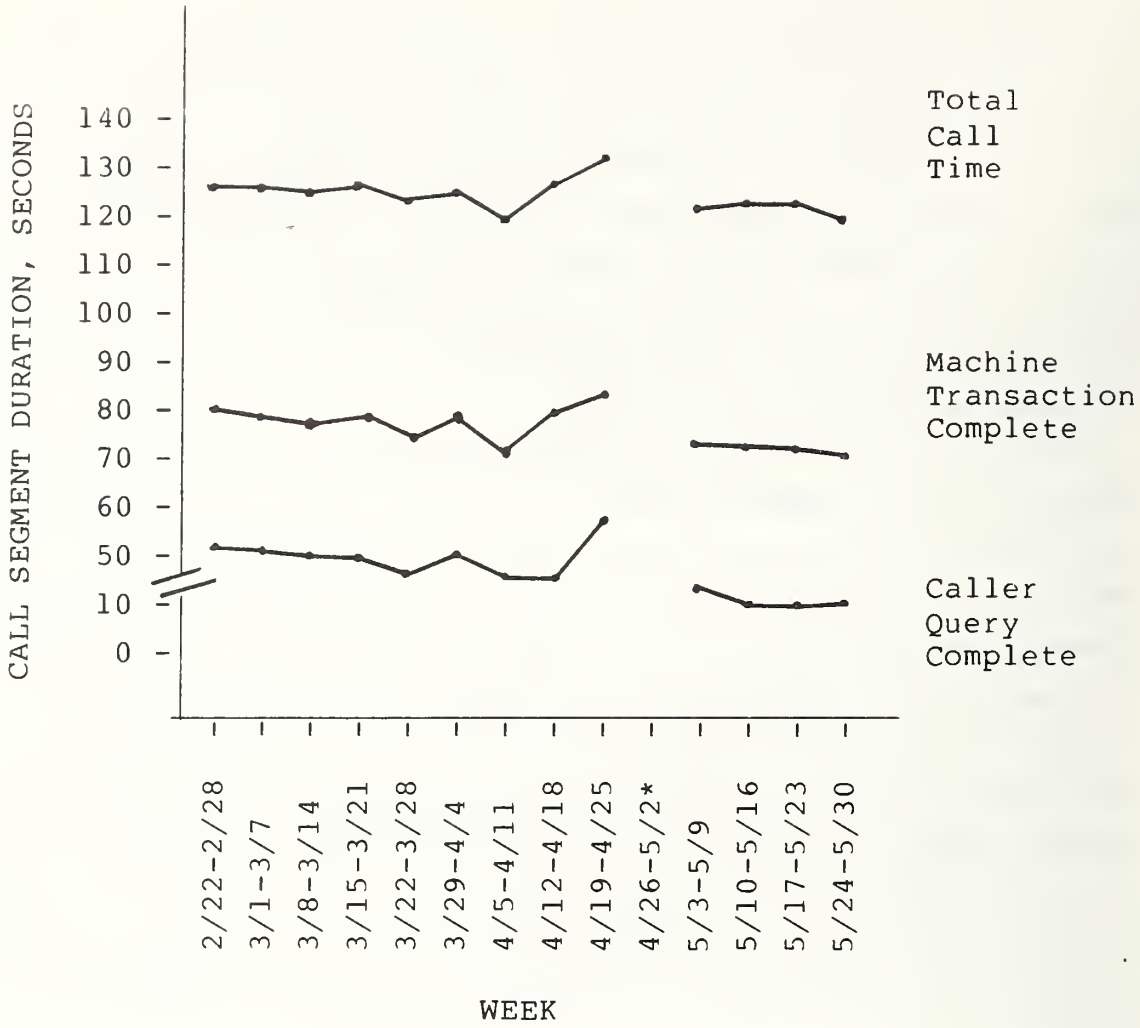

FIGURE 3-16. CCIS CALL SEGMENT DURATIONS
AVERAGE FOR EACH WEEK OF THE TEST PERIOD

Source: CCIS Log File
* Missing from CCIS Log File Data

TABLE 3-4. CCIS CALL SEGMENT DURATIONS
AVERAGES FOR EACH WEEK OF THE TEST PERIOD

WEEK	CALLER QUERY	MACHINE INTERACTION	AGENT RESPONSE	TOTAL CALL TIME
2/22-2/28	:54	:25	:48	2:07
3/1-3/7	:51	:26	:48	2:05
3/8-3/14	:50	:25	:47	2:02
3/15-3/21	:51	:26	:47	2:04
3/22-3/28	:48	:24	:49	2:01
3/29-4/4	:51	:22	:49	2:02
4/5-4/11	:47	:19	:49	1:53
4/12-4/18	:47	:27	:49	2:03
4/19-4/25	:58	:19	:54	2:11
4/26-5/2*	*	*	*	*
5/3-5/9	:45	:22	:48	1:55
5/10-5/16	:42	:25	:49	1:56
5/17-5/23	:43	:25	:48	1:56
5/24-5/30	:44	:22	:47	1:53
AVERAGE	:49	:24	:49	2:01

* Missing from CCIS Log File Data

Source: CCIS Log File

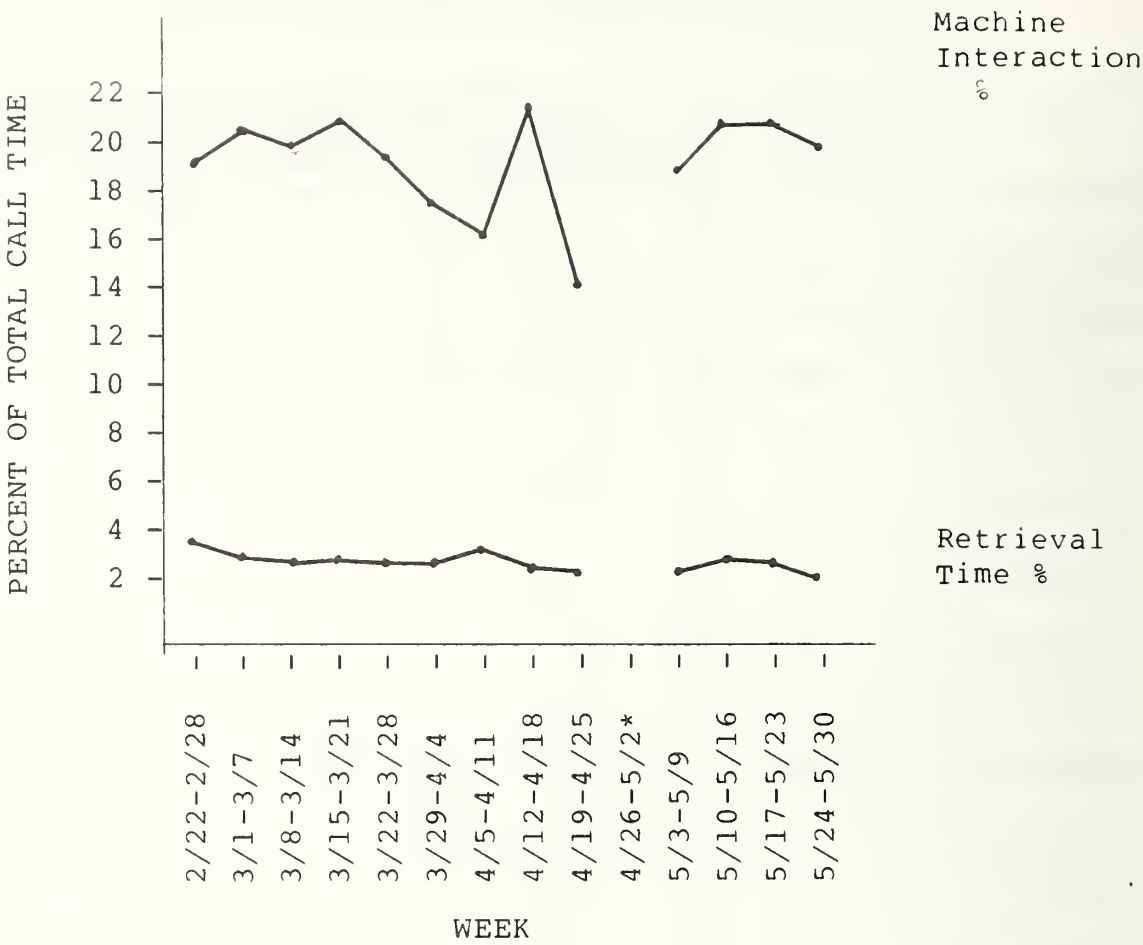

FIGURE 3-17. MACHINE INTERACTION AND DATA RETRIEVAL TIMES AS PERCENTAGES OF TOTAL CALLS TIMES AVERAGES FOR EACH WEEK OF THE TEST PERIOD

Source: CCIS Log File data
* Missing from CCIS Log File Data

on average to complete their calls than did the more experienced agents. Call times for the novice agents as a group averaged over five minutes while call times for intermediate and advanced agents averaged approximately three and one-half minutes. Call time differences between intermediate and advanced agents were less dramatic, with the intermediate agents actually performing slightly faster (seven seconds on average) than the advanced agents on all of the nine-question test sections. These results might suggest that average call times decrease with increasing job experience only up to a point, beyond which call times remain relatively stable.

Table 3-6 presents average agent call times broken down by mode of data retrieval. The agents using the CCIS mode of data retrieval had the fastest overall call times, averaging approximately three minutes and 51 seconds per response. The manual mode agents ranked second overall with an average call time of four monutes and three seconds, while the mixed mode agents were third overall with an average call time of four minutes and twenty seconds. Analysis of variance results show that there were few statistically significant differences between modes; they do show, however, that the order in which test questions were asked did not affect agent responses.

Table 3-7 provides a comparison of individual agent performance in the experiment as measured by projected hourly call rates, i.e. average call times divided into 3600 seconds per hour. As can be seen from this table, the fastest overall were the intermediate and advanced CCIS agents, followed by the intermediate mixed and manual mode agents. The advanced mixed and manual agents are next, followed by the novice agents in the manual, CCIS, and mixed modes, respectively. The slowest agents, by far, were the novice CCIS and the novice mixed mode agent, who used CCIS most of the time.

TABLE 3-5. AVERAGE AGENT CALL TIMES
GROUPED BY EXPERIENCE/SKILL LEVEL
(IN MINUTES AND SECONDS)

LEVEL OF AGENT SKILL/ EXPERIENCE	QUESTION SET (Question Numbers)				
	I (1-9)	II (10-18)	III (19-27)	IV (28-36)	TOTAL (1-36)
NOVICE	6:02	5:50	4:14	4:52	5:15
INTERMEDIATE	3:48	3:32	2:58	3:27	3:27
ADVANCED	4:11	3:56	2:41	3:28	3:34
ALL AGENTS	4:40	4:26	3:18	3:55	4:05

Source: CCIS Controlled Experiment

(Note: The experiment was divided into four sets of nine questions each in order to obtain information suitable for performance of analysis of variance in 9x9 element latin squares; this also limited the number of test subjects to nine.)

TABLE 3-6. AVERAGE AGENT CALL TIMES
GROUPED BY MODE OF DATA RETRIEVAL
(IN MINUTES AND SECONDS)

MODE OF DATA RETRIEVAL	QUESTION SET (Question Numbers)				
	I (1-9)	II (10-18)	III (19-27)	IV (28-36)	TOTAL (1-36)
MANUAL	5:01	4:08	3:28	3:35	4:03
CCIS	3:58	4:30	3:07	3:50	3:51
MIXED	5:02	4:40	3:18	4:21	4:20
ALL AGENTS	4:40	4:26	3:18	3:55	4:05

Source: CCIS Controlled Experiment

TABLE 3-7. AVERAGE CALL RATES FOR EACH TEST AGENT (IN CALLS PER HOUR)

AGENT SKILL/ EXPERIENCE LEVEL	MODE OF DATA RETRIEVAL		
	MANUAL	CCIS	MIXED
NOVICE	13.1	11.1	10.4
INTERMEDIATE	16.3	19.1	17.1
ADVANCED	15.3	19.9	15.9

Source: CCIS Controlled Experiment

Another variable of interest in comparing agent performance is the variability in the call times recorded. When the standard deviations of agent call times were calculated they showed that the intermediate and advanced CCIS agents were the most consistent in their call times, while the novice manual and mixed mode agents were the least consistent.

The data that were presented in Tables 3-5, 3-6, and 3-7 clearly show that the nine agents participating in the controlled experiment posted average projected hourly call rates that were generally below the SCRTD standard of 20 calls per hour, and far below the average projected call rates calculated by the CCIS log file during the test period. Three different explanations might be advanced for this discrepancy between experimental and "real world" results. They are:

- Experimental effects;
- Difficulty of test questions; and
- Agent experience.

These are discussed below:

Experimental effects are those factors influencing agent performance arising out of the experiment itself. Because of the configuration of the telephone system at SCRTD, it was impossible to test the agents at their normal work stations. Instead, they were isolated in one of their training rooms for the experiment, so that the calls could be placed to them directly. Because of this isolation, agents participating in the experiment may have felt for some reason they were being singled out for closer observation. Furthermore, because they were advised that call time and response accuracy were being measured, they may have felt, despite consultant reassurances to the contrary, that the experiment was designed to give SCRTD management an in-depth view of their job performance. For these reasons, agents may well have been both more nervous and more cautious in their responses than they would ordinarily have been at their own work stations. Both of these factors would mitigate towards longer responses.

Agents and SCRTD management both agreed that the queries selected for use in the experiment were generally more complex than average calls encountered by agents during the normal performance of their jobs. This is not surprising, since test questions were constructed to measure the itinerary-building capabilities of the CCIS as well as the manual agents. As shown in the CCIS log file data, experienced agents are able to respond to certain familiar and frequently-recurring queries without reference to any data about 25% of the time. These "off the top of the head" responses obviously take far less time than those for which either manual or computer data retrieval is required, and tend to increase substantially an agent's average call rate. None of the queries in the experiment was so easy that data retrieval was unnecessary. In fact, all of the queries requested construction of a complete itinerary from point A to point B, and most involved further information references beyond this itinerary request. As a result, the difficulty of the test questions may well have been a factor in producing longer agent call times.

The novice agents ranked seventh, eighth, and ninth in terms of overall call productivity. Their relatively slow performance tended to diminish the overall call rates for each retrieval mode. This effect was especially true for the CCIS mode, where the average call rate for the novice was a full eight calls per hour slower than that of the advanced agents.

For a more detailed presentation of CCIS Controlled Experiment methodology and results, see the companion report entitled The CCIS Experiment: Comparing Data Retrieval Modes at the SCRTD.

3.5 QUALITATIVE DATA COLLECTION

The wealth of quantitative data collected by the system evaluation contractor and the SCRTD yielded the very detailed descriptions of caller demand, agent performance, and call characteristics described above. They did not, however, provide enough information to satisfy all the objectives of the system evaluation. Many aspects of CCIS operations were difficult to quantify. For this reason, a number of qualitative data collection activities were also undertaken. These qualitative evaluation activities had three major objectives:

- To gain insights into the opinions and attitudes of both CCIS and manual agents concerning the system; its overall accuracy, its impact on their normal job functions, its influence on their overall job satisfaction, etc.;
- To ascertain SCRTD management perceptions as to how system implementation was progressing, how effectively it was meeting desired objectives, etc.; and
- To obtain suggestions for potential improvements or enhancements to the system.

Three separate techniques were employed by the evaluation contractor in obtaining this qualitative information. They were:

- Survey questionnaires of both manual and CCIS agents;
- In-depth interviews of key SCRTD personnel involved in system implementation; and
- Qualitative grading of agent responses obtained in the CCIS controlled experiment.

3.6 QUALITATIVE EVALUATION METHODOLOGY

In reviewing alternative methods for performing an evaluation of the qualitative aspects of the CCIS, the method which appeared to provide the most complete understanding of the system's impacts on agent and supervisor attitudes was a before-and-after approach. Based on this decision, two separate sets of agent attitudinal surveys were designed and administered, and two separate series of management interviews were conducted, before and after the 90-day quantitative evaluation period. The "before" surveys and interviews were conducted in October and November 1980, and the "after" data were collected in June 1981. Because it was considered useful to determine opinions of both manual and CCIS agents, a separate survey was administered to each group on each occasion.

Qualitative data concerning CCIS operation were also produced as a result of the CCIS controlled experiment. Agent responses to each of the 36 test questions as recorded by the contractor in the experiment were graded by a panel of impartial graders in the SCRTD Planning department as well as the Information Section Training Supervisor. In the grading process, major emphasis was placed on the accuracy and completeness of each response. Before the grading process began, agent identities and their modes of information retrieval were removed from response logs so as to eliminate any possible bias on grading results induced by these two factors. While this grading process relied on subjective judgments and consistency of the graders, it nevertheless provided a good basis for distinguishing the relative quality of agent responses.

3.7 QUALITATIVE EVALUATION RESULTS

In the following section, results of the various qualitative data collection instruments are described. The "before" agent survey results are described first. Next, the "after"

survey results are presented and compared with the "before" results where possible. Analyses of the response quality grading of the CCIS controlled experiment are then described. Finally, summaries of interviews of eight key SCRTD personnel involved in CCIS implementation are provided.

3.7.1 "Before" Agent Survey Results

The "before" surveys for manual and CCIS agents were designed to encourage maximum agent participation. Overall length was limited to approximately 15 questions, most of which were presented in a multiple-choice format. For several questions, however, blanks were provided for "open-ended" responses by agents who chose to volunteer additional information. Response to the survey was excellent. A total of 25 CCIS and 47 manual agent surveys were completed and returned for processing. Survey responses were coded numerically by the consultant and analyzed using a Statistical Package for the Social Sciences (SPSS) program which yielded frequencies for each possible response type as well as cross-tabluations of certain data items of interest.

3.7.1.1 Manual Agent "Before" Survey Results - Manual agents were asked a total of 12 questions of which 7 allowed multiple-choice response selection and 5 provided for open-ended responses. Agent responses to each are presented below:

- The first questions in each of the surveys administered dealt with agent experience and call count under busy conditions, i.e., conditions under which the agent can answer calls continuously. The first columns of Tables 3-8 and 3-9 present the manual agent "before" responses to these questions. Manual agents responding to the survey tended to be well-experienced, with an average job tenure of at least 22 months. Their self-admitted call counts generally ranged from the upper teens to low twenties per hour.

TABLE 3-8. RESPONSES TO SURVEY QUESTIONS
REGARDING AGENTS' EXPERIENCE
(% OF TOTAL AGENTS RESPONDING)

AGENT EXPERIENCE	MANUAL		CCIS	
	BEFORE SURVEY	AFTER SURVEY	BEFORE SURVEY	AFTER SURVEY
0 - 6 Months	9	7	4	0
7 - 12 Months	6	3	0	0
1 - 2 Years	38	23	32	23
2 - 3 Years	6	17	16	29
Over 3 Years	40	50	48	48
TOTAL AGENTS RESPONDING	47	30	25	31

TABLE 3-9. RESPONSES TO SURVEY QUESTIONS REGARDING AGENTS' HOURLY CALL COUNTS (% OF TOTAL AGENTS RESPONDING)

HOURLY CALL COUNT UNDER BUSY CONDITIONS	MANUAL		CCIS	
	BEFORE SURVEY	AFTER SURVEY	BEFORE SURVEY	AFTER SURVEY
15 or Less	4	3	0	3
16 - 20	26	30	36	23
21 - 25	49	43	52	58
26 - 30	17	20	8	13
Over 30	4	3	4	3
TOTAL AGENTS RESPONDING	47	30	25	31

- Each survey also contained questions in which agents were asked to rate their individual job performance and job satisfaction. The vast majority of manual agents in the "before" survey rated their abilities as "excellent" or "good". Manual agent job satisfaction was for the most part rated "good", although 10 agents responded "fair" or "poor". The first columns of Table 3-10 and 3-11 present these self-ratings.
- Manual agents were fairly evenly divided on the question "Do you feel that you have reached your full potential in performing as a transit information agent?". A total of 45% replied "yes" to this question, while 38% replied "no"; and 17% chose the "don't know" response.
- Manual agents were also asked the frequency with which they used map books (Thomas Guides) in providing caller responses. A similar question asked the frequency with which agents used no references whatever in answering calls. These frequencies were of interest because map book use tends to slow down agent call counts, while responses "off the top of the agent's head" tend to increase them. The responses to these two questions are shown in Table 3-12. They show that manual agents responding to the survey use map books quite frequently, and no references somewhat less so.
- To the question "What part of your job causes you the most problem?", several alternative answers were provided as well as a blank labelled "other" for additional information to be supplied by the agent. "Poor comprehension by the caller" was by far the most popular reply; 80% of the manual agents chose this. This was by far the highest total for any single response. Only two agents chose the response "understanding the caller's

TABLE 3-10. RESPONSES TO SURVEY QUESTIONS REGARDING AGENTS' ABILITY (% OF TOTAL AGENTS RESPONDING)

AGENT SELF-RATING CATEGORY	MANUAL		CCIS		
	BEFORE SURVEY	AFTER SURVEY	BEFORE SURVEY	AFTER SURVEY	
			ABILITY USING CCIS	ABILITY USING CCIS	ABILITY USING MANUAL
EXCELLENT	38	53	16	23	52
GOOD	60	43	36	58	45
FAIR	2	3	32	16	3
POOR	0	0	16	3	0
TOTAL AGENTS RESPONDING	47	30	25	31	31

TABLE 3-11. RESPONSES TO SURVEY QUESTIONS REGARDING AGENTS' JOB SATISFACTION (% OF TOTAL AGENTS RESPONDING)

AGENT JOB SATISFACTION RATING CATEGORY	MANUAL		CCIS	
	BEFORE SURVEY	AFTER SURVEY	BEFORE SURVEY	AFTER SURVEY
EXCELLENT	8	*	13	19
GOOD	65	*	54	55
FAIR	16	*	25	23
POOR	11	*	8	3
TOTAL AGENTS RESPONDING	37	*	24	31

* This question was not included on the manual agents' after survey.

TABLE 3-12. FREQUENCY WITH WHICH AGENTS USE MAP BOOKS* OR NO REFERENCES IN PROVIDING CALLER RESPONSES "BEFORE" SURVEY RESULTS (% OF TOTAL AGENT RESPONSES)

AGENT FREQUENCY RATING	CCIS		MANUAL	
	MAP BOOKS	NO REFERENCE	MAP BOOKS	NO REFERENCE
HARDLY AT ALL	0	4	2	8
SOMETIMES	20	56	9	23
FREQUENTLY	48	24	49	38
VERY FREQUENTLY	32	16	40	31
TOTAL AGENT RESPONSES	25	25	47	47

* Thomas Guides, used for providing walking instructions or locating caller addresses.

question"; and only one agent chose the response "retrieving the information in reference material". None of the agents felt that using the map book (Thomas Guide) to locate the caller or give walking instructions" caused them any problem as compared with the other response alternatives. A total of 14 agents volunteered additional information under the "other" response. Problems cited by these agents covered a wide variety of issues, the most frequently mentioned of which were rude or abusive callers and management pressures for higher productivity. Other responses included the quality of the manual reference materials, the physical layout of the manual work area and agent boredom.

- The question "What duties do you like most about your job?" did not suggest any alternative answers but merely provided a blank in which an agent could write his or her own response. A total of 42 manual agents responded to this question. By far, the most common answer was "helping people". Other responses included "giving out accurate information" and "receiving praise from customers". Several agents also mentioned their job security as union members.
- The question "What duties do you dislike most about your job?" produced a total of 39 agent responses. Once again, no suggested responses were supplied; only a blank was provided for agents to fill in their own. A variety of different dislikes were raised by the agents. The most frequent response could generally be stated as "dealing with difficult customers". Agents evidently experience considerable frustration in having to be pleasant to callers who use abusive language or who fail to understand repeated instructions. The next frequent response could be termed "management pressure to achieve high call counts". Other management prac-

tices such as logging agent time spent in rest rooms and prohibiting talking or smoking at work stations were also criticized, as was the relative inaccessibility of shift supervisors. Several agents mentioned other job-related complaints such as monotony, looking up information for foreign lines (other bus companies in the Los Angeles area with which the agents are unfamiliar) and trying to adjust schedule information to delays encountered in the real world.

- Manual agents were asked the question: "Why do you prefer manual call processing over using the CCIS?" Since initial training for CCIS was done on a voluntary basis, it was assumed that those agents who did not apply for CCIS training preferred manual data retrieval. For this question, several alternative responses were provided, together with a blank labelled "Other (please explain)". The response most frequently chosen (by a total of 20 agents) was "I'm more effective using the manual method". Five agents selected "negative experience with CCIS", while another four agents selected "I'm more comfortable with manual". A total of 21 agents chose to provide additional information in the "other" response. Many of these agents criticized the CCIS as being too slow, not comprehensive enough, or subject to frequent changes. Others mentioned unfamiliarity with the equipment or poor typing skills that led to frequent errors. One agent criticized the accuracy of CCIS response screens: "When the CCIS has reached the point of accuracy that you can, with clear conscience, give information solely from the screen, then I would love to use it". Many of the manual agents stated that they had merely missed out in the sign-up process and would like to try the CCIS.

- The final open-ended question was "How can the manual processing method be improved to help you in your work"?. On this question, no responses were suggested; a blank was provided for agent response. A total of 43 out of the 47 agents filled in responses to this question. Slightly over half this total suggested that the manual reference materials be kept in good condition and up to date. Many agents complained that the schedule books were unwieldly and in ragged or poor condition. Several suggested that references be set in larger print or laid out in a more readable fashion. Others suggested changes to the physical layout of the information center which might reduce the number of times agents have to leave their work stations to find a particular reference. A few of the agents felt that better management attitudes towards the needs of the agents would improve the system. One agent suggested the recording played to callers while waiting for an available agent be changed so as to better prepare callers to state their queries in a format useful to the agent.

Tables 3-13 and 3-14 present the results of cross-tabulating the responses to certain of the manual survey questions. In Table 3-13, agent perceptions of overall ability are cross-tabulated against agent experience. In this table, it can be seen that agent perception of ability generally increases with experience. Table 3-14 presents call count per hour when busy vs. experience as an agent. The distribution of responses on this table generally supports the notion that call count increases with experience.

3.7.1.2 CCIS Agent "Before" Survey Results - In their "before" survey, CCIS agents were asked a total of 14 questions, five of which permitted open-ended responses. Agent responses to each are summarized below:

TABLE 3-13. MANUAL AGENTS "BEFORE" SURVEY
CROSS TABULATION OF CALL COUNT VS EXPERIENCE

CALL COUNT WHEN BUSY	AGENT EXPERIENCE					TOTAL
	0-6 MONTHS	7-12 MONTHS	1-2 YEARS	2-3 YEARS	3 OR MORE YEARS	
15 or Less	1	1	0	0	0	2
16 - 20	2	1	3	0	6	12
21 - 25	1	1	9	2	10	23
26 - 30	0	0	6	0	2	8
Over 30	0	0	0	1	1	2
TOTAL	4	3	18	3	19	47

TABLE 3-14. MANUAL AGENTS "BEFORE" SURVEY
CROSS/TABULATION OF ABILITY VS EXPERIENCE

ABILITY RATING	AGENT EXPERIENCE				
	0-6 MO.	7-12 MO.	1-2 YR.	2-3 YR.	OVER 3 YR.
EXCELLENT	1	0	7	3	7
GOOD	3	3	11	0	11
FAIR	0	0	0	0	1
POOR	0	0	0	0	0
TOTAL	4	3	18	3	19

- As in the manual survey, CCIS agents categorized their overall job experience and hourly call counts under busy conditions. These responses are shown on the third columns of Tables 3-8 and 3-9. The CCIS agents responding were as a group slightly more experienced; their average job tenure was approximately 25 months. Hourly call counts for the CCIS agents were generally in the upper teens to lower twenties, very comparable to the manual agents responding.
- CCIS agents were also asked in their "before" survey to rate their abilities. Responses to this question are tabulated in the third column of Table 3-10. It is evident that the CCIS agents surveyed have a lower opinion of their abilities using new technology than do their counterparts using manual methods. This result is also reflected in CCIS agent responses to the question "Do you feel that you have reached your full potential in using the CCIS?" A total of 75% of the agents responded "No".
- The third column in Table 3-11 provides CCIS agent responses to the survey question regarding agent job satisfaction. The percentages of agents rating their job satisfaction as "excellent" or "good" are quite comparable to those for the manual agents in their "before" survey.
- CCIS agents were also asked to evaluate the manner in which the CCIS had impacted their overall job satisfaction. Responses to this question are shown in Table 3-15. Results show that agents were fairly evenly divided between the "positive influence" and "no influence" responses. Only one agent chose the "negative influence" response.

TABLE 3-15. CCIS AGENT RESPONSES TO SURVEY QUESTIONS REGARDING CCIS INFLUENCES ON JOB SATISFACTION (% OF TOTAL AGENT RESPONSES)

AGENT PERCEPTION OF CCIS INFLUENCE	BEFORE SURVEY	AFTER SURVEY
POSITIVE	52	84
NEGATIVE	4	0
NO INFLUENCE	48	16
TOTAL AGENTS RESPONDING	25	31

- Table 3-12 displays CCIS agent "before" survey responses to questions concerning the frequencies with which they consult their map books (Thomas Guides) and with which they are able to provide caller responses without recourse to any reference material. From this table, it is evident that CCIS agents responding to the survey are just as likely to use the map books as their manual counterparts. They are less likely, however, to respond to callers "off the tops of their heads". Perhaps this result is due to the ease and speed with which the CCIS can be consulted, as compared with the manual reference materials.
- The CCIS agents, all of whom had been trained on and used manual data retrieval methods before system implementation, were asked to compare CCIS vs. manual call processing across a number of different categories. Table 3-16 shows the results of these comparisons. These results indicate that the CCIS was rated very favorably in a number of categories by the CCIS agents. Of particular interest is the fact that 80% of these agents felt that CCIS made their jobs easier, while only three felt that CCIS was worse than manual in this respect. In the category "ability to handle multiple requests", the CCIS received its most unfavorable rating, with 32% of the agents stating that CCIS was worse than manual and an additional 20% more stating that the two systems were about the same in this respect. In the categories of "accuracy" and "caller satisfaction", the "about the same" responses outnumbered "better" and "worse" responses. Over all the comparison categories, the CCIS received "better" ratings on about 53% of the responses; "about the same" ratings on about 31%, and "worse" ratings on only 16%.

TABLE 3-16. CCIS AGENT COMPARISONS OF MANUAL VS CCIS INFORMATION PROCESSING FOR VARIOUS COMPARISON CATEGORIES (% OF TOTAL AGENT RESPONSES)

COMPARISON CATEGORY	RATING CATEGORY					
	BETTER		WORSE		SAME	
	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
RETRIEVAL SPEED	64	81	12	6	24	13
ACCURACY OF INFORMATION	40	77	12	3	48	19
DETAIL OF INFORMATION	52	71	16	0	32	29
ABILITY TO HANDLE MULTIPLE REQUESTS	48	55	32	26	20	19
MAKING JOB EASIER	80	84	12	0	8	16
PROVIDING SATISFACTION TO THE CALLER	24	58	12	6	64	35
OVERALL CAPACITY	60	77	16	0	24	23
PERCENT OF ALL RESPONSES	53	73	16	6	32	21
TOTAL AGENTS RESPONDING	25	31	25	31	25	31

- Several alternative answers were provided for the questions "What part of the CCIS causes you the most problems?", as well as a blank labeled "other" for agents to supply additional information if they chose to do so. Eight agents chose the response "Which key function to use"; two chose "evaluating the information on the screen before giving it to the caller", and 12 chose to supply their own responses under the "other" response. These 12 agents cited a variety of system-related problems, including the following:
  (1) Not enough key functions are supplied, causing agents to do more typing than is necessary.
  (2) Translating customer requests into CCIS functions.
  (3) Slow or inaccurate responses, or insufficient detail.
  (4) Not enough agent training.
  (5) Inflexibility in handling multiple requests, causing the agent to re-enter functions numerous times.
- CCIS agent responses to "before" survey questions regarding aspects of their jobs most liked and disliked were very similar to manual agent responses. Regarding aspects liked most, the most frequent response supplied by the agents was "helping the public"; this response was cited by 32% of the agents. Other responses included "intelligent customers", "giving out useful information", "helping customers save money", and "union security". Regarding aspects disliked the most, a total of 40% of the agents singled out "dealing with difficult or abusive customers". Other dislikes included looking up information for foreign lines, boredom, dealing with management pressure, and CCIS breakdowns.

- The CCIS agents were most responsive to the final open-ended question "How can the CCIS be improved to help you in your work?". A total of 22 out of 25 agents filled in suggestions. The most frequent response to this questions was "expand the CCIS systemwide". Other suggestions included:
  (1) Make the key functions more flexible.
  (2) Make data on bus transfers easier to retrieve. One agent cited the "inability to get next connection, first connection, and last connection without extensive manipulation of time inputs."
  (3) Add walking instructions to the system. The CCIS explicitly lacks this capability at present; for this reason the agents must consult their map books when giving walking instructions.
  (4) Increase response accuracy.
  (5) Add smaller streets to the dictionary of recognized landmarks.
  (6) Speed up system response time.
  (7) Add a backup computer to the system to reduce down time.
  (8) Increase initial agent training.

Tables 3-17 and 3-18 illustrate the results of two cross-tabulations run on CCIS "before" survey results. Table 3-17 contains data for CCIS agents similar to data in Table 3-13 for manual agents, and cross-tabulates agent call counts vs. job experience. The pattern of responses in this table supports the general notion that agent call count increases with experience. Table 3-18 plots the frequency with which agents use no reference materials in response to caller queries vs. agent experience. While the distribution of responses in this table is rather scattered, it generally confirms the idea that increased experience is correlated with increased agent ability to respond "off the tops of their heads".

TABLE 3-17. CROSS-TABULATION OF AGENT CALL COUNT VS JOB EXPERIENCE RESPONSES CCIS AGENT "BEFORE" SURVEY

CALL COUNT PER HOUR WHEN BUSY	EXPERIENCE AS AN AGENT					TOTAL
	0-6 MO.	7-12 MO.	1-2 YR.	2-3 YR.	OVER 3 YR.	
15 OR LESS	0	0	0	0	0	0
16-20	1	0	2	3	3	9
21-25	0	0	6	1	6	13
26-30	0	0	C	0	2	2
OVER 30	0	0	0	0	1	1
TOTAL	1	0	8	4	12	25

TABLE 3-18. CROSS-TABULATION OF "NO REFERENCE" RESPONSE FREQUENCY VS AGENT JOB EXPERIENCE
CCIS AGENTS "BEFORE" SURVEY

FREQUENCY OF "NO REFERENCE" RESPONSES	EXPERIENCE AS AN AGENT					TOTAL
	0-6 MO.	7-12 MO.	1-2 YR.	2-3 YR.	OVER 3 YR.	
HARDLY AT ALL	0	0	0	0	1	1
SOMETIMES	1	0	5	3	5	14
FREQUENTLY	0	0	2	0	4	6
VERY FREQUENTLY	0	0	1	1	2	4
TOTAL	1	0	8	4	12	25

3.7.2 "After" Agent Survey Results

The "after" surveys administered to both CCIS and manual agents were very similar in both form and content to the "before" surveys. In some instances, questions identical to those in the "before" surveys were asked of each group. Once again, agents were highly cooperative in completing the survey; a total of 30 manual and 31 CCIS surveys were returned for processing. Responses were coded and analyzed using SPSS methods similar to those used in the "before" survey.

3.7.2.1 Manual Agent "After" Survey Results - In their "after" survey, manual agents were asked a total of 11 questions, two of which allowed open-ended responses. Agent responses are presented below.

- As in the "before" surveys, manual agents were asked to report their job tenure and call count under busy conditions. Their responses are shown in the second columns of Tables 3-8 and 3-9. Once again, manual agents responding to the survey were generally well-experienced, with call counts in the upper teens to lower twenties per hour on average. These results are very similar to the manual agent "before" survey responses.
- Manual agents were again requested to rate their overall abilities. Their responses to this survey question are shown in the second column of Table 3-10. Manual agent self-assessments were once again quite high, with over half the respondents classifying themselves in the "excellent" category, and all but one of the remainder rating themselves "good".

All the manual agents had presumably had the opportunity at some point during the 90-day test period to at least observe the CCIS in operation, if not to try it out for themselves. A total of 20 of the 30 manual agents responding to the "after" survey

indicated they had received instruction in CCIS use as part of the revised agent training program instituted by SCRTD management during this period. As a result, it was assumed that the manual agents had formed some opinions regarding CCIS, and a series of questions on these agents' "after" survey attempted to document these opinions.

- To the question "Which do you feel is the best method of information processing?" only 13% of the manual agents replied "manual only"; seven replied "CCIS only"; 53% replied "mixture of manual and CCIS"; and 10% replied "don't know".
- When asked "Would you like to learn to use CCIS?", 73% of the agents replied "yes", 7% replied "no" and 17% replied "don't know". A follow-up question asked agents to explain this response in an open-ended fashion. Explanations for agent desire to learn CCIS included "improves call count" (17%); "increases job skills" (10%); "makes the job better" (17%). Explanations for agent aversion to learning CCIS included "poor typing skills" (7%) and "problems with CCIS accuracy" (13%).
- When asked "Do you feel that learning to use CCIS would increase your job satisfaction?", 60 of the agents responded "yes", while 20% responded "no" and 20% responded "don't know".
- Manual agents were asked to predict how learning to use CCIS would affect their hourly call counts. Survey responses to this question are shown in Table 3-19. A total of 50% of the manual agents felt their call counts would increase, 14% felt that they would remain the same, and 36% felt that they would probably decrease. This response indicates at least some apprehension on the part of the manual agents concerning their abilities to interact effectively with the computer.

TABLE 3-19. "AFTER" SURVEY RESPONSES TO QUESTIONS REGARDING INFLUENCE OF CCIS ON AGENTS' CALL COUNT (% OF TOTAL AGENTS RESPONDING)

AGENT PERCEPTION OF CCIS INFLUENCE	MANUAL AGENTS*	CCIS AGENTS**
INCREASE	50	45
SAME	14	41
DECREASE	36	14
TOTAL AGENTS RESPONDING	28	29

* "How do you feel that learning to use the CCIS would affect your hourly call count?"

** "How has using the CCIS affected your hourly call count?"

- The final two questions on the manual survey dealt with manual agent opinions concerning the proposed expansion of the CCIS to cover the entire SCRTD service area. A total of 75% of the manual agents expressed favorable responses, while only 14% were opposed. Another 11% replied "don't care". When asked to explain this response in an open-ended question, a total of 22 agents provided responses. Of these, eight emphasized that CCIS retrieval speed was much faster than manual, five cited CCIS response accuracy, and three stated that the proposed expansion would improve their jobs. Of those agents explaining their opposition to the proposal, four mentioned problems with CCIS accuracy and two others noted that they had poor typing skills.

3.7.2.2 CCIS Agent "After" Survey Results - In their "after" survey, CCIS agents were asked a total of 13 questions, of which 3 permitted open-ended responses. Agent responses are presented below.

- CCIS agents were also requested to again report their job tenure and call count under busy conditions. Their responses are shown in the fourth columns of Tables 3-8 and 3-9. Responses were very similar to previous manual and CCIS surveys. On the whole, the CCIS respondents were more experienced than the manual: union seniority giving day-shift preference to the more experienced agents is one explanation for this result. Call counts reported by the CCIS agents were once again at or near 20 per hour on average, the SCRTD standard.
- CCIS agents were again asked to rate their abilities in using the system. Their self-assessments are shown in the fourth column of Table 3-10. It is evident from these data that the CCIS agents became more

comfortable with automated information retrieval during the 90-day test period, as the percentage of agents rating their abilities as "excellent" or "good" increased by 30% over the "before" survey results. Because the "before" survey had shown such marked differences in ability ratings between manual and CCIS agents, the CCIS "after" survey also included a question asking the CCIS agents to rate their abilities using manual retrieval. These ratings are shown in the fifth column of Table 3-10. They are interesting in that they indicate the CCIS agents still considered themselves considerably "better" at using manual retrieval than at using the CCIS. It should be noted, however, that half of the CCIS agents responding had been using the system for less than six months and were probably not yet fully proficient using CCIS.

- The CCIS "after" survey also contained two questions pertaining to agent job satisfaction. The first of these questions asked for a general opinion of overall agent job satisfaction. Responses to this question are shown in the fourth column of Table 3-11. These responses are only marginally different from the "before" survey responses, and indicate a generally high level of satisfaction among CCIS agents. Only one agent responded "poor" to this question. The second question asked for agent opinion concerning the influence of the CCIS on the agents' job satisfaction. Responses to this question are shown in the second column of Table 3-15. These responses are considerably more supportive of the CCIS than those of the CCIS "before" survey, and reflect a shift of opinion for over 30% of the agents from the "negative" or "no influence" to the "positive" response.

- CCIS agents were also asked in the "after survey to characterize the influence of system implementation on their productivity as measured by hourly call counts. Responses to this question are shown in the second column of Table 3-16. These results indicate that about the same percentage of CCIS agents as manual agents felt that CCIS had increased or would increase their call counts. About 25% more of the CCIS group, however, felt that the system had no influence on their call counts as opposed to the decrease foreseen by the manual agents.
- CCIS agents were again asked to compare CCIS versus manual call processing over a variety of different rating categories. This survey question was identical to one asked in the "before" survey. Comparison of the "before" and "after" responses to this question may thus provide insights into changes in agent attitudes towards the system which may have developed during the course of the 90-day test period. The second, fourth and sixth columns in Table 3-16 show the "after" survey responses to this question. Comparison of These responses to the "before" responses indicates that CCIS agents once again rated the system very favorably; in fact, the ratings they assigned are generally higher than those given in the "before" survey. All of the agents responding to this question rated the CCIS as "about the same" or "better" in the category "making your job easier". Once again, the CCIS received its lowest overall rating in the category "ability to handle multiple requests"; with 36% of the agents stating that CCIS was worse than manual and an additional 19% stating that the two retrieval modes were about the same in this regard. In the categories of "accuracy" and "caller satisfaction", agents this

time rated CCIS better than manual by sizable margins. These responses represent a substantial shift from the "before" survey in which the "about the same" responses outnumbered the "better" and "worse" responses in these two rating categories. Over all comparison categories, the CCIS was rated "better" than manual by 73% of agent responses; "about the same" by about 21%, and "worse" by only 6%.

- A similarly high rating of the system was indicated by CCIS agents in response to the question "What aspect of the CCIS causes you the greatest problem?". In response to this question, agents were given a choice of four "problems" which had been frequently mentioned in the "before" surveys, plus a blank labeled "other" for a more detailed open-ended response. The most frequent response to this question, given by a total of 11 agents, was "no problems" entered in the "other" category. Problems cited by other respondents included "typing in caller information" (9 agents) and completeness/accuracy of CCIS responses" (8 agents). Only two agents responded "choosing which function to use", a considerable decrease in this category from the results of a similar question in the "before" survey. Perhaps this difference indicates an increase in agent familiarity with the various key functions and their capabilities and limitations.
- CCIS agent responses to the open-ended question "How can CCIS be improved to help in your work?" can be grouped into two categories. The first includes those of ten agents who suggested improvements to the key functions and other machine capabilities such as:

(1) 'Scrolling' schedule screens which enable an agent to see considerably more schedule information on the response screen for a given bus route than is ordinarily provided by a schedule function reference.

(2) Addition of at least rudimentary walking instruction capabilities.

(3) Changing the schedule function so that agents can compare schedules of two alternative bus routes displayed at the same time on the screen.

(4) Temporary storage capabilities for itinerary information so it can be retrieved without delay if other functions are also called up. At present, use of other functions "erases" this information from the response screen.

(5) Adding information section paperwork functions to the CCIS software; i.e. time sheets, progress reports, agent bidding for shifts, vacation times, etc.

The second response category, which included 13 agents, consisted of suggestions to expand the geographic scope of the CCIS to include the entire SCRTD service area.

- As in the "after" manual survey, the final two questions on the "after" CCIS survey dealt with agent opinions concerning the proposed expansion of the geographic scope of the CCIS. CCIS agents overwhelmingly favored this proposal: 94% of the agents replied "favor the idea" while only 3% replied "oppose the idea" and 3% replied "no opinion".

When asked to explain this response in an open-ended follow-up question, 24 agents responded. Of these, nine cited CCIS retrieval speed, five mentioned CCIS accuracy, five stated that it made their jobs easier, four noted increased caller satisfaction, and one

mentioned that it helped develop new job skills.

Tables 3-20 through 3-22 present results of cross-tabulations of interest run on various responses to the CCIS "after" survey. Table 3-20 presents a cross-tabulation of CCIS influence on call count responses vs. agent experience responses. This table shows that CCIS had a greater positive influence on the call counts of agents with less than 3 years experience than those agents having over 3 years of experience. Table 3-21 presents a similar cross-tabulation, this time showing CCIS experience versus CCIS influence on call count. From this table, it can be seen that a greater percentage of those agents recently introduced to the CCIS (less than 3 months experience) claimed reductions in their overall call counts than did agents having greater CCIS experience.

Table 3-22 shows "experience using CCIS" responses tabulated against "problems using CCIS responses". This table shows that "choosing which function key to use" was cited by only two less-experienced agents, while "typing in caller information" and "CCIS accuracy" are problems noted at all experience levels. "No problems" was another response cited by agents of all CCIS experience levels.

3.8 CCIS CONTROLLED EXPERIMENT RESPONSE QUALITY RESULTS

All 324 agent responses logged during the course of the CCIS controlled experiment were graded by SCRTD Planning Department personnel and by the Supervisor of Training in the Information Section. In the grading process, major emphasis was placed on the accuracy and completeness of each response. To judge accuracy and completeness, each agent response was compared with a "best" itinerary or other response as determined independently by the graders. The determination of this "best" response was made using SCRTD manual reference materials available on the date of the experiment. Since the CCIS data base relied on these same manual materials for updating, it was

TABLE 3-20. CROSS-TABULATION OF AGENT PERCEPTIONS REGARDING CCIS INFLUENCE ON CALL COUNTS VS JOB EXPERIENCE CCIS AGENT "AFTER" SURVEY

CCIS INFLUENCE ON CALL COUNT	EXPERIENCE AS AN AGENT		
	1-2 YRS	2-3 YRS	OVER 3 YRS
REDUCTION	1	0	3
NO INFLUENCE	3	2	7
INCREASE	3	6	4

TABLE 3-21. CROSS-TABULATION OF AGENT RESPONSES REGARDING EXPERIENCE USING CCIS VS AGENT PERCEPTIONS OF CCIS INFLUENCE ON HOURLY CALL COUNT
CCIS AGENT "AFTER" SURVEY

AGENT EXPERIENCE USING CCIS	CCIS INFLUENCE ON CALL COUNT		
	REDUCTION	NO INFLUENCE	INCREASE
OVER 6 MONTHS	1	7	8
3-6 MONTHS	1	4	3
3 MONTHS OR LESS	2	1	2

TABLE 3-22. CROSS-TABULATION OF AGENT RESPONSES REGARDING EXPERIENCE USING CCIS VS AGENT RESPONSES CONCERNING PROBLEMS USING CCIS
CCIS AGENT "AFTER"SURVEY

AGENT EXPERIENCE USING CCIS	PROBLEMS USING CCIS			
	FUNCTION KEYS	TYPING ERRORS	ACCURACY OF CCIS	NO PROBLEM
OVER 6 MONTHS	0	5	4	7
3-6 MONTHS	1	3	2	1
3 MONTHS OR LESS	1	1	2	3

assumed that the manual and CCIS data bases contained comparable information on the date of the experiment. The primary criterion for judging the accuracy of each response focused on the question:

> "Using the response information provided by the agent, can the caller actually make a trip from Point A to Point B in view of query input?"

The answer to this question provided a simple and decisive standard for determining overall response quality. If the caller could indeed make the trip, the response was rated satisfactory (S). If the caller could not make the trip, the response was rated unsatisfactory (U).

Assessing the completeness of the information provided in each response focused on those itinerary instructions volunteered to the agent. Items emphasized included the following:

- bus route selection
- schedule information
- transfer information
- fare information
- walking instructions (if requested)

All those responses assigned satisfactory (S) ratings in the accuracy grading were evaluated for completeness using these criteria. They were assigned a numerical rating based on a progressive scale of one (minimal information provided) to ten (all necessary information provided). A response with an "S-10" rating was therefore comparable to the "best" response as determined by the SCRTD graders.

A review of agent response grades, which are presented in Appendix C, reveals that there was some variability to grades assigned, but the preponderance of these grades fell within the S-6 to S-10 range. Responses in this range, which accounted for 79% of the total, might be termed "useful". Responses assigned grades in the S-1 to S-5 range, which might be characterized as "marginal", accounted for an additional 12% of

the total. Unsatisfactory grades were assigned in 28 cases, or 9% of the total.

From the frequencies of unsatisfactory and marginal grades assigned, as shown in Table 3-23, it can be seen that Question Sets I and II were found to be the more difficult by the test agents. These question sets accounted for 67% of all marginal responses and 75% of all unsatisfactory responses.

Comparison of agent grades received broken down by skill/ experience level, shown in Table 3-24, demonstrates important differences between the three groups. As might be expected, the agents of the advanced group scored considerably higher than did the other two groups: 86% of all their responses were in the useful range. The intermediate agents were next best at providing accurate responses with 79% of their responses in this range. Comparison of unsatisfactory grades by each group reveals a reverse ranking.

Comparisons of agent response grades by mode of data retrieval also reveal interesting differences among the three modes. Table 3-25 shows the relative frequencies of useful, marginal and unsatisfactory grades by mode of data retrieval. The agents in the mixed mode group, who were allowed to use either CCIS, manual or a combination of both, were clearly rated the best at providing the most accurate and complete responses. The mixed mode group received the most useful (S-6 to S-10) ratings of the three groups, with 83% of its total receiving grades within this category. The mixed mode group also received the lowest overall unsatisfactory rating, with only 21 responses, or 19.4% of its total, in this category.

Examination of Table 3-25 shows that the manual and CCIS modes are very evenly matched in terms of response quality, with the CCIS slightly behind in terms of useful and unsatisfactory grades, but ahead in terms of marginal grades.

TABLE 3-23. FREQUENCY OF RESPONSE QUALITY GRADES RECEIVED BY ALL TEST AGENTS

RESPONSE GRADE	QUESTION SET				TOTAL	% OF TOTAL
	I	II	III	IV		
S-10	6	6	18	8	38	12
S-9	12	19	26	25	82	25
S-8	22	8	15	20	65	20
S-7	10	13	11	13	47	15
S-6	9	9	2	4	24	7
S-5	7	7	3	3	20	6
S-4	5	3	2	2	12	4
S-3	2	0	0	3	5	2
S-2	1	0	0	0	1	0
S-1	1	0	0	0	1	0
U	5	16	4	3	28	9

TABLE 3-24. RELATIVE FREQUENCY OF RESPONSE QUALITY GRADES RECEIVED GROUPED BY AGENT SKILL/EXPERIENCE LEVEL
(% OF TOTAL FOR EACH GROUP)

GRADE ASSIGNED	EXPERIENCE/SKILL LEVEL		
	NOVICE	INTERMEDIATE	ADVANCED
USEFUL (S-6 to S-10)	73.1	78.7	86.1
MARGINAL (S-1 to S-5)	13.9	13.9	8.3
UNSATISFACTORY (U)	13.0	7.4	5.6

TABLE 3-25. RELATIVE FREQUENCY OF RESPONSE QUALITY GRADES RECEIVED GROUPED BY MODE OF DATA RETRIEVAL

GRADE ASSIGNED	MODE OF DATA RETRIEVAL		
	MANUAL	CCIS	MIXED
Useful (S-6 to S-10)	77.8	76.9	83.3
Marginal (S-1 to S-5)	13.9	10.2	12.0
Unsatisfactory	8.3	12.9	4.7

Table 3-26 provides a comparison of individual response quality ratings for each agent participating in the experiment. As can be seen in this table, the novice CCIS agent clearly scored the poorest of all the agents, with only 65% of his responses falling into the useful category. The manual and mixed novice and the manual intermediate might be grouped next, with between 70% and 78% useful responses. The advanced manual, intermediate CCIS and mixed and advanced CCIS agents rank next, with 83% to 86% of their responses in this category. The advanced mixed mode agent clearly scored the highest, with 89% useful responses and only one unsatisfactory response.

The novice computer mode agent did so poorly on the test that it would seem reasonable to hypothesize that he had not yet fully mastered the use of the terminal keyboard, the format screens, or the full range of computer transactions available through CCIS. His response quality scores are so low that they tend to diminish the overall showing of the CCIS agents as a group, particularly in light of the fact that the novice agents for the other two modes posted fairly respectable response quality scores. Perhaps a fairer comparison between the three modes could be achieved by eliminating novice agent scores from consideration, and using only intermediate and advanced agent scores. The results of such a comparison are shown in Table 3-27, which presents relative frequencies of grades received grouped by mode with novices excluded.

As can be seen by comparing this table with Table 3-25, elimination of novice agent scores makes no difference to the percentage of useful responses in the manual agent group. It does, however, raise the useful percentage of both the CCIS and mixed mode groups to a level where there is little difference between them. The mixed mode group, however, still ranks highest overall in terms of fewest unsatisfactory responses. This result is somewhat expected in light of the considerably longer average

TABLE 3-26. FREQUENCY OF RESPONSE QUALITY GRADES RECEIVED BY EACH TEST AGENT

RESPONSE QUALITY GRADE ASSIGNED	MODE								
	MANUAL			CCIS			MIXED		
	NOV	INT	ADV	NOV	INT	ADV	NOV	INT	ADV
USEFUL (S-6 to S-10)	28	25	31	23	30	30	28	30	32
MARGINAL (S-1 to S-5)	5	7	3	5	3	3	5	5	3
UNSATIS-FACTORY	3	4	2	8	3	3	3	1	1

TABLE 3-27. RELATIVE FREQUENCY OF RESPONSE QUALITY GRADES RECEIVED GROUPED BY MODE OF DATA RETRIEVAL
NOVICE AGENTS EXCLUDED
(% OF TOTAL FOR EACH GROUP)

RESPONSE QUALITY GRADE ASSIGNED	MODE OF DATA RETRIEVAL		
	MANUAL	CCIS	MIXED
USEFUL	77.8	83.3	86.1
MARGINAL	13.9	8.3	11.1
UNSATISFACTORY	8.3	8.3	2.8

call times of the mixed mode group as compared to the other two modes of data retrieval; i.e., they took extra time to double-check their responses between the two modes.

3.9 SUMMARIES OF INTERVIEWS WITH KEY SCRTD PERSONNEL

As part of the overall CCIS evaluation, a number of interviews were conducted with SCRTD personnel who were instrumental in system implementation and who managed system operations on a day-to-day basis throughout the 90-day test period. These personnel, grouped by SCRTD Department, included:

- Telephone Information Section:
  - Chief
  - Senior Supervisor
  - Senior Instructor
  - CCIS Program Manager
- Customer Relations
  - Director
- Scheduling Department
  - Advance Planner
- Stops and Zones
  - Supervisor
- Planning Department
  - Director and Chief Planner

While the content of each "before" and "after" interview varied, an attempt was made to focus on the interviewees' perceptions of CCIS impacts on their jobs and on the jobs of their subordinates. These impact areas were often discussed by the interviewees more in terms of projected impacts that in actual verified impacts. Their viewpoints reflected the pilot nature of the project and the fact that the SCRTD was just "getting up to speed" in terms of steady-state pilot CCIS operation at the time the interviews were conducted. In a sense the interviewees said "based on what we see now, these are the real impact areas". Interviewee perceptions varied according to familiarity with CCIS operations.

Some of those interviewed gave detailed reactions to the CCIS, some speculated on possible uses and/or impacts, and others knew very little about the system.

3.9.1 Telephone Information Section

3.9.1.1 The Chief of the Telephone Information Section felt that the CCIS may provide more administrative and managerial flexibility by decreasing time dedicated to personnel scheduling, shift assignments, policies, procedures and disciplinary actions. Regarding the impacts felt by the agents, the Chief stated that the CCIS should be able to relieve some of the mental stress involved in manual information retrieval; this may help reduce agent fatigue.

The Chief also stated that the implementation of the CCIS would have a major, beneficial effect on the job of Information Section supervisors. At present, many supervisors are operationally "rusty" due to their unavailability to the agents in terms of assisting with call processing problems or work procedures. Almost all the supervisor's time is presently consumed in updating the printed manual reference material in the Summary Books at each agent's work station. The CCIS, by incorporating automated data base updating, may free supervisors to return to their intended role as information systems managers and monitors, and as guidance personnel available to the agents. Less clerical responsibility for the supervisors would also provide more time for enrolling them in outside training courses (e.g., management seminars) for further professional development. The CCIS would also require a different, more trouble-shooting type of in-depth training course for supervisor applicants.

CCIS implementation would also, the Chief mentioned, have a significant impact on Information Section recruitment and hiring practices. The Chief felt that the CCIS may make it easier to recruit both older personnel and part-time workers

for the position of transit information agent. Older personnel (e.g., middle-aged and up) have been difficult to recruit in the past due to the intensive memorization requirements in the training course; experience with these personnel, however, has shown them to be the most reliable and competent performers. Hiring part-time workers has been difficult due to the eight to nine week training course and full-time scheduling; many young college students (many with related skills) could perform as agents on a part-time basis. Use of part-time workers would also provide more flexibility in scheduling vacations and extended holiday weekends for full-time senior personnel.

Finally, the Chief mentioned that the CCIS, if implemented on a metropolitan areawide basis, may enable the SCRTD to provide information on other bus services such as those in Long Beach, Santa Monica and Gardena. The Telephone Information Section presently answers numerous calls dealing with these "foreign" lines with little assurance that the information regarding them is updated or accurate. The CCIS might provide the means for centralizing information on all Los Angeles area public transit systems.

Summing up the overall impacts of the CCIS, the Chief stated that implementation of the pilot system enabled the Telephone Information Section to provide better service to more people.

3.9.1.2 Senior Supervisor - The Senior Supervisor of the Telephone Information Section stated that implementation of the CCIS initially made the job much more complicated, as it involved coordinating a system which was unfamiliar to the agents and the supervisors. After the CCIS Program Manager was appointed, the job became much easier. The Program Manager's most important contribution was in providing technical management for CCIS operations while effectively dealing with the agents' problems. In effect, the Program Manager

took the load of direct CCIS management off the Senior Supervisor's back. The Program Manager, incidentally, was supported by a full-time assistant who performed the data base updating function. The job of Senior Supervisor is presently 80% paperwork, comprised of keeping employee time records, recording call counts from the ACD counter (15-20 minutes per hour) and completing route activity reports. Much of this work could be done automatically, with minor additions to CCIS reporting functions. If such software changes are made, the CCIS could decrease the Senior Supervisor's overall paperwork load by at least 50% and permit the performance of more dedicated supervision work with subordinate supervisors and agents. The Senior Supervisor presently has a staff of 15 regular supervisors, 6 of which are on duty at any given time.

Regarding the impact of CCIS on the Supervisor's job, the Senior Supervisor agreed with the Information Section Chief's opinion that the regular agents currently have the edge over the supervisors in terms of information knowledge and processing skill. By removing the updating function from the supervisor's job, the CCIS could change this situation by giving the supervisor position greater attractiveness and responsibility; supervisors would possess more system knowledge by virtue of greater training and experience. Supervisors would also have the time to troubleshoot system problems occurring on the floor. Finally, agents would have more professional incentive to compete for the supervisor position (at present there is only a $2 per hour difference in salary between supervisor and agent).

3.9.1.3 Senior Instructor - The Senior Instructor has responsibility for directing the initial training of all newly-hired agents. Traditionally, the Senior Instructor and two other full-time instructors conducted training courses of 8 to 9 weeks' duration, during which agents began to practice

on telephone equipment in the sixth week. By reducing the memorization requirements of this manual course, the Senior Instructor estimated that the CCIS should be able to decrease initial agent training time from the present 8 to 9 weeks down to 4 to 6 weeks. It still will be necessary to teach trainees the basics of:

- Service area geography
- Call management strategies and communications
- Basic SCRTD data on routes, schedules, and fares

The new training schedule might involve simulated calls after two weeks and "live" calls, under the supervision of an instructor, after three to four weeks. Each instructor would work with two agents at any given time.

Regarding the job of instructor, the Senior Instructor mentioned that approximately 25% of instructor time is presently dedicated to updating the 34 sets of Summary Books in the Instruction Office. An additional five to six hours per week of instructor time is spent proofing the printed material for accuracy. The CCIS could decrease or eliminate these efforts with some form of centralized updating; however, an alternate form of quality control, with staffing, would have to be established for the computer system. The cost impact of these measures is unclear at present; however, some insight into labor savings can be gained by using the present instructor base salary level of $1725 per month.

Regarding the job of Information Section Supervisor, the Senior Instructor observed that supervisors at present really only perform the duties of clerks in terms of updating the 95 sets of Summary Books used by the agents. The CCIS could "free up" their time for more professional management duties such as promoting call count productivity and monitoring the public relations aspects of the telephone information service.

On other personnel related matters, the Senior Instructor noted that the CCIS may make it easier and cheaper to recruit and train personnel. The problem in this area is demonstrated by the statistics on the last SCRTD recruitment effort: 600 individuals responded to a newspaper job advertisement, 400 took the test at Los Angeles City College, 150 passed, 50 were interviewed, 18 reported for training, 3 graduated from the course and one of these 3 has since resigned.

Although this is the least productive SCRTD recruitment effort to date, it does provide some insight into the resources expended in this overall effort. Major reasons for losing trainees include the relatively low agent pay scale ($5.34 per hour), the difficulty in learning the job and the repetitive nature of the tasks. The CCIS may help address this recruitment problem by opening up the job to both older personnel and part-time workers.

3.9.1.4 CCIS Program Manager - The CCIS Program Manager, who was appointed to direct daily CCIS operations as of February 1, 1981, reports to the Senior Supervisor. The Program Manager is assisted by a Deputy Program Manager whose job consists almost entirely of performing CCIS update functions, and who is required to perform liaison tasks with other SCRTD departments in order to obtain the most accurate data base possible for the CCIS.

With the cooperation of the Senior Supervisor, one of the Program Manager's first tasks was to write a new training manual for the agents employing user-oriented language. This manual was well received by the work force. Using this manual, agents were trained in a "refresher" course for a full day in groups of five. A typical training exercise would involve one agent using the CCIS with the other 4 agents observing. Emphasis in the refresher course was placed on explaining <u>why</u> the system chose the answers shown on the response screen. The subsequent certification process involved a written pass/fail test; a

failed written test resulted in an on-line CCIS operation test for certification. A total of 42 agents successfully completed this refresher course.

The Program Manager stated that interesting training insights were gained from working with two temporary workers (Kelly girls) in the Information Section; these individuals were of average skill level and were trained and working the CCIS telephones within one week. This experience may indicate that training time for new agents can be decreased even below the projected four to six week figure stated by the Senior Instructor. It should be emphasized, however, that these two temporary workers already possessed highly developed typing skills, which many of the regular agents lacked.

The CCIS Program Manager had charge of ensuring operational quality of the system during the 90-day test period (February 22 - May 22). From an operations standpoint, the 90-day test period was broken down into three 30-day periods. The first month's effort focused on promoting usage, monitoring agent progress, receiving agent feedback and developing standards for performance. The second month of the test involved the development of the "load factor" ranking to indicate the degree of rush hour ridership on the bus routes presented on the response screen; this was an effort to direct passenger demand to available bus system capacity. Agents were also interviewed during this period and an attitude change was evident involving a preference for the CCIS over the manual system. The third month focused on attaining a steady-state operation with high productivity levels. Agents demonstrated an increasing ability to handle relatively simple requests (e.g., schedule times) using the CCIS; initially the system was largely used to process more difficult queries.

The Project Manager indicated overall productivity results in the third month were not as high as expected; this result

was attributed to a certain amount of unaccounted non-work time (i.e., between calls) probably resulting from checking material, breaks, etc., as discussed in Section 3.3.3.

System retrieval times however, were quite satisfactory and generally ranged from four to eight seconds depending upon the time of day.

The Program Manager reiterated opinions expressed by others regarding the impact of the CCIS on the job of the supervisor. The Manager also stated that the CCIS data base is far more accurate than the manual, despite the best efforts of the supervisors. This accuracy, he said, can have a very positive effect on the agent's confidence.

The CCIS, the Program Manager stated, can be of use to the SCRTD Planning department in the assessment of the need for new bus routes by aggregating origins and destinations of callers using the log file.

3.9.2 Customer Relations

3.9.2.1 Director of Customer Relations - the Director of Customer Relations, who oversees all of the SCRTD's marketing functions, including the Telephone Information Section, stated that the pilot CCIS project was an expression of the SCRTD's confidence in the ability of computer technology to help transit agents. The Director's stand has been to support the CCIS providing it can do the job (accurate, responsive information) and can be accepted by the user. From a cost perspective, the Director stated that there is no objective of decreasing the number of agents through the use of this technology. Rather, ideal implementation objectives would be elimination of the manual information retrieval system and higher productivity of the work force.

When asked to comment upon the relative success of the CCIS in meeting its objectives, the Director observed that after an extended "limbo" period, a 6-month concentrated effort seems to have brought the user and the system together. The interviewer discussed the fact that the attainment of a reasonable level of success in the pilot program does not automatically imply success in a full systemwide implementation effort; this possibility was acknowledged. Interdepartmental issues, the Director stated, clearly had to be part of the CCIS expansion decision.

3.9.3 Scheduling Department

3.9.3.1 Advance Planner - The advance Planner in the SCRTD's Scheduling Department stated that his responsibility was the establishment of basic operating schedules for buses on all system routes. This procedure involves receiving the stop list from the Stops and Zones Department and keypunching each stop with associated geographic data (digitized census coordinates, census tract, county) to produce an integrated master list of stops. This process is accomplished on a dedicated IBM 1401 computer system. The master list is then used to describe bus routes in terms of bus stops. The Scheduling Department's bus stop - bus route information is then used by the Planning Department as a data base. For CCIS data base development the Scheduling Department provided tapes from their IBM 1401 system to be read into the Univac 1106 mainframe.

The CCIS, in the opinion of the Advance Planner, has potential applications to several areas related to the Scheduling Department. First, an integrated transit systemwide data base would provide a more efficient means of developing the integrated master list of stops. This integrated transit system data base would also assist the SCRTD in determining overall service delivery policy, which must be developed based

on pupulation and ridership; the central data base could be used to describe each route by the stops, and to calculate route miles for each route. This automated calculation of route miles could also be used to determine the cost of contract services provided by SCRTD outside the Los Angeles County area.

In view of the Advance Planner, the strategy of automatically updating a systemwide CCIS data base with schedule data is a worthwhile one. However, it depends on two operational requirements: first, the conversion of the IBM 1401 programs for Univac requirements; and second, the installation of a planned minischeduler for use as an interactive scheduling tool. Completion of these tasks would allow the Scheduling Department to consider direct involvement in updating a systemwide CCIS data base. When asked to comment on the magnitude of the cost savings associated with the development of this integrated systemwide data base, the Advance Planner stated that the full system CCIS would not provide huge savings to the Scheduling Department, but it would provide several opportunities for doing its business much more efficiently.

3.9.4 Stops and Zones

3.9.4.1 Supervisor - The Supervisor of the Stops and Zones Department of the SCRTD is responsible for the entire SCRTD system of bus stops and zones. This activity includes maintenance of a word processor listing of all 30,000 stops and zones in the SCRTD service area. The supervisor is also responsible for making changes in stops and zones; these can result from new routes, abondoned routes, new buildings, handicapped service curb improvements, etc. The Stops and Zones Department provides a list of stops and zones to the Scheduling Department for their use in developing time tables and headway sheets. Finally, the Supervisor is responsible for stop signage and other hardware used to mark stop locations.

The Supervisor has not been involved in the CCIS program and was not aware of its detailed features. However, the Supervisor did note that the system may be valuable in two areas relating to the Stops and Zones Department. First, an integrated transit system data base, including the listing of stops and zones, would appear to be of value given the exchange of transit data between different SCRTD departments. Second, CCIS printed output may be useful in the Informational Signing Program. This program involves posted sign boxes at each stop which contain route and schedule information; these are serviced frequently due to route and schedule changes, as well as vandalism.

3.9.5 Planning Department

3.9.4.1 Director and Chief Planner - the Director and Chief Planner of the SCRTD Planning Department are responsible for planning bus routings in order to be responsive to passenger demand. The Planning Department conducts surveys and ridership checks to assess the status of potential and existing ridership demand. Ridership is determined using both point checks (at stops) and riding checks. Data needed to evaluate routings include passenger flows and the identification of relatively small neighborhood-sized geographical demand areas. Conceptual routes are developed and subjected to actual testing. If a new route is approved by the SCRTD, the Scheduling Department is directed to design an operating schedule, and the Stops and Zones Department is directed to design and implement a series of stops along the route.

The Planning Department has not been involved to any significant degree in the CCIS pilot project other than in providing route descriptions. In addition, not much thought has been given to the potential of the CCIS to the Planning Department on a full system basis. The interviewer explained

the potential of the CCIS log file in aggregating call origins and destinations by some level of geographic detail. The Director of Bus Planning acknowledged that such a system feature might be of considerable value for planning purposes.

4.0 CONCLUSIONS

A review of the quantitative and qualitative data collected by the system evaluation contractor and presented in the preceeding chapters leads to generally positive findings concerning the performance of the CCIS in its pilot demonstration. While the implementation process was rather extended and somewhat laborious due to a variety of internal and external problems, trends in the data collected show that most of these problems have been corrected and the system is, for the most part, currently functioning as originally intended. The SCRTD management, the system design contractor, and the information agents using the system all demonstrated a great deal of dedication and perseverance in bringing about this result.

This generally favorable assessment of system performance can be supported by a variety of data which indicate that the CCIS is achieving a number of its intended implementation objectives. Among these objectives are:

- Increased agent productivity resulting from faster data retrieval.
- Increased accuracy and consistency of agent responses.
- A reduction in training time required for new agents, and in on-the-job experience required for full proficiency.
- Improved capability to rapidly incorporate changes in the reference data base.
- An improvement in the agent's overall job satisfaction.
- Expanded capabilities to collect data on agent and system performance.
- Use of the transit and geographic data base supporting the system as a data resource by other transit authority departments such as those dealing with route planning, stop locations, and service schedules.

A discussion of CCIS performance in each of these objective areas follows.

4.1 AGENT PRODUCTIVITY

Data collected during the course of the evaluation leads to rather conflicting conclusions concerning system influence on agent productivity. Under rigidly controlled conditions during the experiment conducted by the evaluation contractor, the intermediate and advanced CCIS agents were appreciably faster in producing responses to the test questions than were the manual and mixed mode agents. Similarly, projected call counts on the CCIS log file, as discussed in Section 3.3.3, for CCIS agents averaged almost 30 per hour, a 50% increase over the SCRTD's manual standard of 20. Yet these same agents during the 90-day evaluation period did not perform at this 30-per-hour figure, in which time spent between calls is assumed to be zero. Their overall percentage of calls answered vs. calls lost is quite comparable to that of the manual (non-Van Nuys Trunk) agents; both groups answered an average of about 60% of total incoming calls, although this result might be a function of manpower allocation and caller demand patterns and not of the CCIS. In addition, the CCIS agents' self-admitted call counts on both the agent "before" and "after" opinion surveys averaged approximately 20 per hour.

The conclusion to be drawn from these conflicting data, developed through consultation with the CCIS Program Manager, is that the system can indeed enable experienced agents to approach the rate of 30 calls per hour. However, it would appear that the stress experienced by an agent working at this pace is too great for it to be sustained for extended periods. The Program Manager stated that the working styles of CCIS agents can be classified into two separate categories. Agents in the first category tend to work at a relatively steady pace of slightly over 20 calls per hour, with brief break, if any, between calls. Agents in the second category tend to work in

spurts, handling a large number of calls in a brief period (at the 30 call per hour rate) and then taking extended breaks to "cool down". The end result of both styles is a call rate approximating 20 per hour, as reported on the agent surveys and observed in practice.

The CCIS Program Manager noted that Information Section management felt the steady-pace working style of the first category was clearly preferable, as it tends to exert much less stress on the agent while producing the same level of performance. A prime advantage of CCIS over manual retrieval, the Program Manager noted, is that all calls, even those involving the most complex itineraries, are of relatively uniform duration and place more uniform demands on an agent's skills. CCIS agents are thus enabled, much more so than their manual counterparts, to develop a steady working pace. In the long run, the Program Manager stated, agent development of typing and call management skill will produce gradual increases in this steady pace.

In the summer of 1981, the installation of new telephone equipment enabled Information Section Management for the first time to monitor and control agent break time. A maximum productivity for the entire Section increased to a rate of approximately 25 calls per agent per hour. Agents were thus forced to adopt the steady-state working pace. Under these conditions, the potential for increased productivity has been realized, although this result is not directly attributable to the implementation of the CCIS.

4.2 RESPONSE ACCURACY AND CONSISTENCY

The CCIS data base, even for the San Fernando Valley demonstration, is large and complex, and problems encountered in its creation (digitizing street addresses, for example) left it filled with numerous "bugs". Similarly, software routines developed for itinerary selection initially made certain over-optimistic assumptions concerning appropriate walking distances,

transfer times, allowances, etc. Over an extended period, refinements and corrections developed in consultation with Information Section management and in response to agent "trouble reports" have gradually reduced this accuracy problem to nearly zero.

Agent responses to the "before" and "after" surveys concerning system response accuracy show a decided shift towards acceptance of CCIS responses. In the "before" survey, only 40% of the agents felt CCIS accuracy was better than manual, while 60% felt that it was about the same or worse. In the "after" survey, 77% felt that CCIS accuracy was better, while 23% felt that it was about the same or worse. Results of the controlled experiment also show that agents using the CCIS produced responses that were graded at least as high on average as those of manual agents, and those using CCIS with manual backup (the mixed mode) produced the highest quality responses. It should be noted that the pilot CCIS deployment is actually such a "mixed" mode configuration since all CCIS agents have a complete set of manual reference materials at their work stations.

It cannot be overemphasized that the debugging and enhancement process was an interactive one in which agents and Information Section management were active participants. This interaction not only resulted in greater accuracy of the data base and a more workable system, but also led to increased confidence on the part of the agents that they were contributing to the usefulness of the system. It is highly doubtful that the pilot demonstration would have been nearly so successful without the establishment of mechanisms to facilitate this interaction. The CCIS Working Committee, Program Manager, and the "trouble report" system are all examples of such mechanisms.

4.3 AGENT TRAINING

Interviews with Information Section management indicated that perhaps the greatest positive impacts exerted by the CCIS on the Section's operations could be realized in the area of agent training. By drastically reducing the need for agent memorization of geographic and route data, the standard agent training period can be cut at least in half. If trainees already possess typing skills, this training period may be even shorter; the CCIS Program Manager cited the experience of training two Kelly Girl temporary employees to reasonable proficiency on the system in only one week. These two employees, however, are the only ones trained to date using only the CCIS.

This reduced training time has strong potential for benefits in the areas of improved personnel recruitment and retention. The work force from which agents are recruited can be greatly expanded to include older and part-time employees, neither of which was suited for the rigorous traditional agent training course. It was the opinion of Information Section management that older employees are generally more dependable, and inclusion of part-time employees in the agent work force would allow management more flexibility than it presently enjoys in the scheduling of full-time agent vacations and other benefits. The long-term implication of these training benefits is significant cost savings to the Telephone Information Section, although the lack of data available makes these savings rather difficult to quantify. It is quite possible that such shifts in personnel management policy might receive opposition from the information agents' union if they are perceived as a job threat to the full-time agents.

4.4 UPDATING OF DATA BASE

Another potential major improvement in Information Section Operations brought about as a result of CCIS implementation

is the capability to perform reference data base updating functions on a centralized basis. One full-time employee at a single terminal can perform the data base updating tasks presently performed almost full-time by 15 supervisors. While manual references would still probably not be eliminated entirely, for backup use in case of computer malfunctions, for example, their number would be greatly reduced from the 95 complete sets currently maintained by the supervisors. As a result, considerable labor savings are anticipated from centralized updating of a service-area-wide CCIS implementation.

A side benefit of centralized data base updating mentioned by almost all of the Information Section management in their interviews would be an improvement in the job of supervisor. At present, supervisors spend practically all their time performing update functions. As a result, their skills as agents tend to gradually diminish to the point where they are inferior to those agents with less job experience. Centralized updating would free the supervisors to perform the functions for which their jobs were originally created: troubleshooting and solving agent problems on the floor as they occur.

4.5 AGENT JOB SATISFACTION

CCIS agent responses to the "before" and "after" surveys give strong support to the hypothesis that implementation of the CCIS has led to an increase in agent job satisfaction. In the "before" survey, 67% of responding agents rated their job satisfaction as excellent or good, while 33% rated it as fair or poor. In the "after" survey, 75% of the agents responding rated their job satisfaction excellent or good and 25% rated it as fair or poor. In the "before" survey, 52% of agents responding described CCIS influence on their job satisfaction as "positive", 44% responded "No influence," and only 4% responded "negative." By contrast, in the "after"

survey, 84% of the responses to the same question indicated "positive" influence, while only 16% indicated "no influence," and there were no "negative" responses. In addition, 75% of manual agents responding on their "after" survey felt that learning to use CCIS would increase their job satisfaction, while 25% felt that it would decrease job satisfaction.

The implication of these results is that a sizable percentage of agents felt that CCIS influenced their job positively, and that this percentage showed an increasing trend over the course of the evaluation period. One agent summarized the influence of CCIS on her job rather humorously: "I don't have to work anymore; I can just talk all day."

4.6 DATA COLLECTION

The development of the CCIS log file as a data collection tool during the course of the system evaluation demonstrated clearly the ability of the system to keep accurate records on all aspects of system performance. Far more data is now available to Information Section management concerning the performance of each CCIS agent and of the entire system than was previously available with the less-reliable ACD data. Furthermore, expanded data collection could free the Senior Supervisor from a great deal of paperwork involving ACD counts, time sheets, etc., yielding more time to work with the supervisors and agents on the floor.

4.7 INTEGRATION WITH OTHER DEPARTMENTS

Although a CCIS Working Committee has been established for the purpose of inter-departmental coordination of CCIS activities, the full benefits of a totally integrated data base incorporating stops, zones, routes, and schedules have yet to be fully realized at the SCRTD. This situation is the result of several factors:

- The CCIS is currently limited to the San Fernando Valley in its pilot demonstration;
- The Stops and Zones and Scheduling Departments currently use their own data processing systems which are incompatible with the Univac 1106 supporting the CCIS;
- Management of other SCRTD departments, which operate fairly autonomously, appear to have little detailed knowledge of the characteristics or potentials of the CCIS.

Should the proposal to expand the CCIS to cover the entire SCRTD service area be adopted by the Board of Directors, considerable attention should be given in system specifications to the creation of a fully integrated transit data base which would be of use to all SCRTD departments.

In conclusion, it is fair to say that the CCIS pilot demonstration has achieved most of its intended objectives, and is currently functioning with the support and confidence of its users. Bringing about this result required dedicated hard work and a spirit of cooperation on the part of SCRTD Management, the system designers, and the information agents. Without this work and cooperation, the system would never have achieved the success which it enjoys today.

APPENDIX A

TOTAL INCOMING CALLS, ALL TRUNKS
6 am - 5 pm

WEEK	SUN	MON	TUES	WED	THUR	FRI	SAT	WEEKLY AVG
2/15-2/21	4831	7180	7157	6875	6797	6318	6736	6558
2/22-2/28	5004	7589	6891	6377	7854	8221	5984	6846
3/1-3/7	4336	5692	6843	6224	6313	6347	5417	5895
3/8-3/14	4633	7114	7130	8527	7886	7468	7032	7113
3/15-3/21	6122	9062	8577	8725	7490	7712	6706	7771
3/22-3/28	5159	8638	8703	8010	7475	7241	7056	7469
3/29-4/4	5001	8721	9159	8233	8494	6842	7526	7711
4/5-4/11	6191	9382	6938	6814	5956	6102	5572	6708
4/12-4/18	5020	6070	6637	6285	6066	5736	5069	5840
4/19-4/25	4500	6793	6209	6290	5747	5753	6189	5923
4/26-5/2	4485	6619	6864	6650	6518	7368	5651	6308
5/3-5/9	4361	6695	8063	6588	6809	6316	5868	6386
5/10-5/16	4420	6888	6480	7367	6578	6848	6096	6382
5/17-5/23	4756	6548	9546	7772	7691	*	*	7044
DAILY AVG	4922	7370	7541	7220	6990	6837	6223	
MAX	6191	9382	9159	8725	8494	8221	7526	
MIN	4336	5692	6209	6224	5747	5736	5069	

OVERALL AVERAGE: 6723

STANDARD DEVIATION: 645

* MISSING FROM ACD DATA

SOURCE: ACD TRUNK GROUP READINGS

APPENDIX B

TOTAL INCOMING CALLS, VAN NUYS TRUNK
6 am - 5 pm

WEEK	SUN	MON	TUES	WED	THUR	FRI	SAT	WEEKLY AVG
2/15-2/21	632	1105	1060	989	984	998	879	950
2/22-2/28	774	1151	898	1066	973	872	866	943
3/1-3/7	571	1227	1128	988	864	873	811	909
3/8-3/14	744	1006	1027	*	856	853	805	882
3/15-3/21	698	1100	1038	980	773	999	835	918
3/22-3/28	560	1090	1089	905	823	960	869	899
3/29-4/4	613	743	937	856	1037	975	904	866
4/5-4/11	746	1105	1096	1067	990	1088	801	985
4/12-4/18	710	1398	1549	1231	1244	1198	712	1149
4/19-4/25	629	1056	1045	1131	813	1102	980	965
4/26-5/2	603	1158	1014	974	1198	1043	848	977
5/3-5/9	668	1184	1084	964	989	984	943	974
5/10-5/16	638	1154	1110	1311	1263	1247	1023	1106
5/17-5/23	623	1009	1467	1148	1050	*	*	1057
DAILY AVG	658	1106	1110	1047	990	1015	867	
MAX	974	1398	978	856	773	853	712	
MIN	560	743	1549	1311	1263	1247	1023	

OVERALL AVERAGE: 972

STANDARD DEVIATION: 83

* MISSING FROM DATA

SOURCE: ACD TRUNK GROUP READINGS

APPENDIX C

CCIS EXPERIMENT - AGENT RESPONSE QUALITY GRADES

QUESTION NUMBER	MIXED			CCIS			MANUAL		
	NOV	INT	ADV	NOV	INT	ADV	NOV	INT	ADV
1	S-9	S-5	S-9	S-3	S-8	S-8	S-8	S-8	S-8
2	S-10	S-4	S-10	S-5	S-4	S-5	S-6	S-8	S-9
3	U	S-8	S-4	S-5	S-6	S-5	S-7	S-9	S-9
4	S-4	S-5	S-8	S-3	S-6	S-8	S-6	S-8	S-4
5	S-7	S-6	S-9	U	S-8	S-6	S-8	S-4	S-7
6	S-6	S-9	S-8	S-9	S-10	S-10	S-6	S-6	S-8
7	S-5	S-8	S-8	U	S-7	S-10	U	S-2	S-8
8	S-9	S-6	S-8	S-7	S-8	S-8	S-8	S-8	S-9
9	S-7	S-9	S-10	S-7	S-9	U	S-7	S-7	S-7
10	S-7	S-5	S-7	U	S-5	S-7	U	S-7	S-7
11	S-7	S-9	S-8	U	S-9	S-9	S-5	S-9	S-9
12	U	S-8	U	U	U	U	S-6	U	S-4
13	S-6	S-4	S-4	U	S-8	S-5	U	U	S-6
14	S-6	S-7	S-10	S-8	S-10	S-9	S-10	S-6	S-7
15	S-8	S-8	S-9	S-6	S-7	S-9	S-9	S-7	S-8
16	S-9	U	S-5	U	S-9	S-9	S-9	U	U
17	S-7	S-9	S-9	S-8	S-9	S-10	S-6	S-5	S-6
18	S-7	S-9	S-10	S-9	S-9	S-10	S-5	S-6	S-7
19	S-7	S-9	S-10	S-9	S-10	S-10	S-7	S-5	S-7
20	S-9	S-9	S-10	S-9	S-7	S-8	S-9	S-5	S-10
21	S-4	S-7	S-8	U	S-7	S-7	S-7	S-9	S-7
22	S-10	S-8	S-7	S-9	U	S-8	S-10	S-9	S-9
23	S-9	S-9	S-10	S-10	S-10	S-10	S-10	S-9	S-10
24	S-9	S-8	S-6	S-8	S-8	S-8	S-8	S-9	S-8
25	S-9	S-9	S-10	S-9	S-10	S-6	S-7	S-9	S-9
26	S-5	S-9	S-8	S-8	S-8	S-8	S-4	S-8	S-9
27	U	S-9	S-10	S-10	S-9	U	S-9	S-10	S-9
28	S-9	S-7	S-10	S-9	S-10	S-10	S-4	S-7	U
29	S-9	S-9	S-9	S-9	S-9	S-9	S-9	S-3	S-8
30	S-7	S-8	S-7	S-8	S-8	S-8	S-6	S-7	S-6

APPENDIX C CONT'D.

QUESTION NUMBER	MIXED			CCIS			MANUAL		
	NOV	INT	ADV	NOV	INT	ADV	NOV	INT	ADV
31	S-3	S-8	S-8	S-3	S-9	S-9	S-8	S-5	S-5
32	S-10	S-7	S-10	S-9	S-10	S-9	S-10	S-9	S-10
33	S-9	S-7	S-9	S-9	U	S-8	S-7	S-9	S-9
34	S-9	S-9	S-8	S-9	S-9	S-7	S-7	S-8	S-9
35	S-8	S-8	S-8	S-8	S-8	S-9	S-8	S-8	S-8
36	S-7	S-6	S-8	S-6	S-4	S-7	S-5	U	S-7

APPENDIX D

REPORT OF NEW TECHNOLOGY

SCRTD - CCIS EVALUATION

This report documents a series of data collection efforts undertaken by Wilson Hill Associates, Inc. at the Telephone Information Section of the Marketing Department of the Southern California Rapid Transit District during 1980 and 1981. The focus of these efforts was a socio-economic evaluation of the impacts of automated transit information systems technology (ATIS), in which state-of-the-art computer systems were introduced for the purpose of information retrieval by transit telephone operators. The prototype computer system at SCRTD is known as the Computerized Customer Information System (CCIS). For the first time, system performance data were collected and tabulated by the computer to complement qualitative and quantitative data collected by evaluation contractor personnel. A 90-day steady-state data collection period was used to assess the changes wrought by automation of data retrieval. Key variables in this assessment were operator call productivity, operator job satisfaction and working attitudes, changes in jobstyles and center operations caused by automation, accuracy and consistency of operator-supplied information, and cost savings attributable to automation.

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