Faculty Working Papers

DEVELOPMENT OF AN ON-LINE CUSTOMER SERVICE INFORMATION SYSTEM

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Summary:

Since around 1970, there has been a significant trend among large organizations to move from a manual system to prepare source data that are later processed in batch environment to an online system that receives and processes data directly entered in the office. This paper describes the course of events taken place in the development of such an online system to process customer orders at a large gas utility company. One significant outcome of the conversion from the previous manual system to the online system was a large reduction in work force required for processing customer orders accompanied by great savings in labor and material costs.

Introduction

The first wave of office automation was caused by the introduction of the first generation of commercial computers in the mid-1950s. It concerned a conversion of repetitive manual work to computerized systems operating in batch processing environment. Observations of such conversions were reported by various authors [1, 2, 3, 4]. Since around 1970, many of the large organizations have been engulfed by what may be rightly called the second wave of office automation. This time, they are converting existing batch processing systems to on-line real-time systems using data bases. This paper reports such a conversion taken place at a large gas utility company.

The company distributes gas to approximately one million families in one of the largest cities of the nation. This case concerns Sales Division and Field Service Division, the two largest of the six divisions constituting the company in terms of the number of personnel. Sales Division consists of three departments; they are Customer Relations Department engaged in sales activity, Customer Account Department engaged in billing customers and collecting their payments, and Meter Reading Department engaged in reading meters on customer premises. Main functions of Customer Relations Department include receiving customer orders for meter connections or disconnections, answering customer inquiries about monthly bills, listening to customer complaints about services, and receiving emergency calls on gas leaks and poor supplies. All these requests are initiated by customers through the telephone, and received and processed by "business representatives" stationed in the downtown main office.

Field Service Division consists of Engineering Department and Service Department; the latter runs three service stations, one in each of the three service districts dividing the city. Each station consists of two shops; one is the field service shop with an average force of 150 service workers who provide services on customer premises, and the other is the pipe shop with an average force of 100 pipe workers who maintain a network of gas pipelines spreading throughout the city. The service work on customer premise is divided into two categories, the regular service and the emergency service. The regular service includes meter connections and disconnections usually performed on the following day of receiving the order, and the emergency service corrective work performed on gas leaks and poor supplies performed on the same day. About 85% of the orders received daily required the regular service, between 10 and 15% the emergency service, and the remaining orders miscellaneous types of work.

Towards the end of the 1960s, the company's top management was considering a major improvement in the existing customer order processing system. The system had been developed over the years of the company's history and was considered nearly perfect as a manual system. In view of the constantly increasing customer calls, however, the top management of the company feared that the system was not processing customer calls as fast as the state utility commission desired. The management was particularly concerned with the time required for the customer to wait before being answered by a business representative staffing the system.

Over the years, the number of business representatives had steadily increased as customer calls increased continuously, but that seemed

never to satisfy the company's goal to answer 90% of all customer calls within 20 seconds after the operator received them. After a deliberation in the spring of 1970, the top management came to a concluson that the system needed a drastic change incorporating latest computer technologies in order to respond to and process a customer call fast enough to satisfy the company's goal, and considered the change an urgent matter.

The Existing System

In 1970, the existing system was staffed by 154 business representatives who processed on the average about 6,500 customer calls. These people were divided into 22 groups of seven people each who sat around a circular work station with a horizontally rotating file of 5" x 8" cards that contained customer premise information. A tape file containing current customer premise information that was updated daily was used to print out new customer master cards for one station per night, therefore taking 22 working days or about a month to update the cards of all 22 stations. In addition, each station was given a listing of daily changes in customer premise information.

The entire customer account numbers were divided into 22 equal blocks. Each block of numbers was handled by a specific station having a unique number listed in the telephone directory.

An incoming customer call was picked up by one of the free business representatives at the station. But about half of the customers dialed a wrong number and therefore were received by a wrong station. Misdialed calls were transferred to right stations by three switchboard operators. On picking up a correctly dialed call, the business representative asked

the name and account number of the customer, located the customer's master card by rotating the file, retrieved the card, and flagged the location. Then the business representative proceeded to process the customer order by writing on an appropriate duplicate form the customer name, address, and account number as shown on the customer master card, and the type of order as well as the date and time of receiving the call. A white form was used for a regular order, and a red form for an emergency order.

Completed forms were placed on a form conveyer leading to an adjoining room where they were picked up by a clerk and separated to their originals and copies. The originals of emergency orders were handed to teletype operators who teletyped the orders to respective field service shops without delay. The originals of regular orders were accumulated until the end of the business hours when they were separated by district and forwarded to respective field service stations by messengers. In a few hours' interval, the copies of both types of orders were sent to the computer center where their data were punched onto cards. At the end of the day, these cards were batch processed to post their data on the current order file.

Preliminary Investigation

In the fall of 1970, a task force was formed, consisting of staff members of Customer Relations Department, Service Department, and System Development Department. Its first task was to determine the extent of computerization possible in the new system. The task force considered two approaches possible for the new system. One approach was to store

the customer archival file containing each customer's 7-year history in microfiche strips and keep the microfiche file in a cabinet in the office of Customer Relations Department. The other method was to install all necessary files online. However, the task force was skeptical of the efficiency of a system using the microfiche file because of the slow speed of retrieving customer records.

During November and December 1970, to learn from the experiences of other companies, the members of the task force visited eight major gas and electric utility companies in the country. With regard to an online customer order processing system four of these companies had already been using the system for one to three years, and the remaining four were in various stages of partial operation, pilot programs, planning, programming or conversion. However, none of these companies used a microfiche file to store customer information, that confirmed the task force's skepticism about the feasibility of using the file with a new system.

In January 1971, the task force submitted a report to the top management, recommending to conduct a detailed study on the feasibility of an online customer order processing system that was to satisfy the following basic requirements:

1. The system should be capable of processing 400 customer calls within a 15-minute interval in peak-load period, equivalent to a call load of 10,000 calls per day.
2. The response time between the request made through the keyboard of a terminal and the display of the customer information on the CRT screen should be 5 seconds or less under normal conditions.

In February 1971, the system study group was organized, consisting of the managers of Information Systems Department, Customer Relations Department, and Service Department. Its objective was to conduct a detailed study on the feasibility of the new system.

Analysis of Call Load

Prior to making the feasibility study, the systems study group requested the Systems and Procedure Section to conduct a call load study to determine the number of business representatives required to staff the system. In industry, this type of problem is usually solved through a simple average method rather than an elaborate mathematical approach. This gas company was no exception. The method used by the company is explained below without critique.

Three separate studies were performed to determine the number of business representatives required:

1. A stop watch time study of individual calls
2. An average time spent on the telephone with a customer
3. A daily call load study

The time study of individual telephone calls and the average time spent on the telephone with a customer were to estimate the average time per telephone call with the online system. As the first step of this study, telephone call statistics for the entire year of 1970 were obtained and charted by day of week. On the average, the number of daily calls was greatest on Monday of the week, dropped about 15% on Tuesday, and then gradually decreased during the remaining days of the week. For example, the median of call load during 1970 gave the following figures:

Monday (6590), Tuesday (5560), Wednesday (5410), Thursday (5390), and Friday (5090). The daily call load varied greatly from month to month, as is illustrated in Figure 1 by the call load on Mondays during 1970. A light load was observed in February, July, and August while a heavy load in September, October and December. The above annual median values of various days of week were more closely approximated by the monthly median values in April than in any other month. As a result, April was selected as an average month to be satisfied in designing the system.

As the second step, statistics were obtained on the number of calls in 15-minute increments from 8:15 a.m. to 5:00 p.m. during 12 consecutive working days in the latter part of April. Although the call load in 15-minute interval fluctuated throughout the day, the business hours could be divided into three periods according to the call load: the morning period or 8:15 a.m. - 12:00 noon, the first afternoon period or 12:00 noon - 2:00 p.m., and the second afternoon period or 2:00 p.m. - 4:30 p.m. Since only two Mondays of the 12 days being studied had a call load in excess of 7,000, it was concluded that a capacity to handle 7,000 calls a day would be satisfactory on most working days. On these two days, the average call load in 15-minute interval was about 250 calls in the morning period, 220 or less in the first afternoon period, and 190 or less in the second afternoon period.

As the third step, a time-motion study was performed during this period, and it found an average time to process a call to be 3 minutes. This meant that a call load of 250, 220, or 190 calls per 15-minute interval needed a staff of 50, 44, or 38 business representatives. Thus Customer Relations Department must employ a total work force big enough

to provide a net available number of 50 business representatives during the morning, peak-load period. Main factors taken into consideration in determining the total work force were: (1) the number of absentees, (2) the number of business representatives under a supervisor, and (3) the schedule for coffee and lunch breaks. The number of absentees was estimated as 10% of the total work force on normal days.

The total work force was to be divided into groups of an equal size appropriate for one supervisor. This size would be in a range of 15-25 people. Two 15-minute coffee breaks, one in the morning and the other in the afternoon, and a 45-minute lunch break would be available to the personnel as before. One lunch period would be in the morning peak period while two lunch periods would be in the afternoon so that all personnel would have a lunch break before 2 p.m. There would be a 15-minute interval between consecutive breaks to clear the personnel of the preceding groups before the following group started its break.

In the morning, peak-load period, no more than one group would be permitted to have a break at any time. The remaining personnel must satisfy the required number of 50. This is written as:

$$E(n - 1)(1 - .1) \geq 50 \tag{1}$$

where E and n are the number of employees in each group under supervisor and the number of such groups, respectively.

During the first afternoon period, those who did not have a lunch break in the first period would take turns to have the break in two separate groups. The personnel remaining at their stations must be equal or greater than 44:

(2) $$\{E + \frac{1}{2} E(n - 1)\} (1 - .1) \geq 44$$

The above conditions (1) and (2) were satisfied by n = 4, where E was found to be 20. In this case, each group would have 18 people available for work, which would provide and expected work force of 54 at work stations in the morning period and that of 45 in the first afternoon period.

The detailed schedule of breaks for four groups of 20 people each was developed by a graphical approach. As is shown in Figure 2, a group of 18 would take a lunch break in the first period and two groups of 27 each would take a break by turns in the second period. For the third period, there would be 16 excess personnel over the required number of 38 when a total number of 54 business representatives in three groups were at work stations at any moment.

Thus, a total work force of 80 business representatives equipped with 68 CRT terminals could easily handle a call load of 7,000 a day. When the call load exceeds 250 calls per 15 minutes, the 20 CRT terminals provided for other departments of Sales Division could be mobilized to assist the 68 CRT terminals in Customer Relations Department. The total of 88 terminals thus available might easily handle a load in excess of 400 calls per 15 minutes, equivalent to a total load of 10,000 calls a day.

A Proposed System

The proposed system was to incorporate the latest computer technologies to enhance the efficiency of processing a customer call and to

satisfy the previously stated requirements, incorporating the following new features regarding system design and procedures:

1. A single telephone number will be assigned to all business representatives to handle all customer calls independent of the customer and the type of service required.
2. The business representative have direct access to data on customer premises and accounts stored in an online file.
3. The business representative enters a customer order directly into an online file.
4. The business representative have direct access to current customer payment data in two online files; one file contains payment data for the past 12 months and the other those for the past seven years.

These new features are now briefly explained relative to the existing system. First, in the new system, all incoming calls would be received by an automatic call distributor that puts them in a queue of 100 slots. The distributor would pick up the call at the front end of the queue and make it available to all business representatives. In contrast, in the existing system, a customer requiring a regular service had to pick up a phone number applicable to his account number out of the 22 listed numbers. The past experience had indicated that only about 50% of the regular service calls had addressed correct numbers, the remaining 50% had been routed to correct stations by switchboard operators. Further, the existing system used a special phone number for all emergency calls that were received and routed by switchboard operators to appropriate file stations according to their account numbers.

Second, the existing card file containing customer premise information at the station would be replaced by an online file. Any business representative could enter new data into or retrieve a record from the file through the keyboard of a CRT terminal. The retrieved record would be displayed on the screen within several seconds of the keying operation. The entering new data would be automatically checked for validity by an edit program and errors found would be displayed on the screen for immediate correction by the business representative.

Third, the business representative would enter customer orders directly into an online file, thus eliminating needs for preparing order forms. If the order entered were an emergency order, it would be promptly transmitted to and printed out by an online printer at an appropriate field service station. Regular orders would be accumulated in the online pending order file during the business hours. In the evening, clerks at each field station would retrieve those orders applicable to the station on their CRT screens to schedule the following day's work for each service worker.

Fourth, in the existing system, data on customer payments for the past seven years were stored in a tape file called the final customer master file that was updated daily. This file was used to update customer payment data for the past 12 months stored in the customer master file, the manual file available at the work station. Unlike the existing system, the new system would make both the final and current customer master files online and directly accessible by the business representative. The retrieval of a customer record in these files would be faster because

the business representative could identify the customer in more ways than the customer account number that was used by the existing system.

Economic Feasibility of the Proposed System

Clerical labor saving was the primary objective of the first office automation, as, for example, was found in a survey conducted by the Bureau of Labor Statistics [3]. Other objectives considered important by the companies included equipment saving, space saving, time saving, greater accuracy, and new information [3; 10]. These objectives are still considered valid today. As objectives of the second office automation, various authors cite fast response to an inquiry, data integrity, operational efficiency due to the elimination of data redundancies in different files, etc. However, many business firms still insist on seeing tangible cost savings associated with a new computer application whether it is in batch processing or online real-time processing. This was also the case with the gas company.

The system study group made a detailed study on the economic feasibility of the new system as shown in Table 1. The summary costs of the proposed system are listed below for brief discussion:

1. Capitalized Costs

(1) Capital Equipment and Installation Costs:

a. Computer equipment	$2,258,400	
b. Computer equipment installation	122,000	
c. Office room renovation	574,000	
d. Furniture and training equipment	65,000	
Total Capitalized Cost		$3,019,400

(2) System Analysis and Development Costs:

Salaries of programmers and systems analysts	1,215,000
Total Initial Investment Cost	$4,234,400

2. Annual Operating Expenses:

(1) Decrease in labor expenses (94 employees)	$1,186,000CR
(2) Decrease in supplies expenses	104,000CR
(3) Increase in computer expenses	123,192
Net Decrease in Operating Expenses	$1,166,808CR

Of the capitalized costs, the purchase price of computer equipment amounting to $2,258,400 was the price of the selected computer, RCA spectra 70 model 6, representing the present value of an annual lease expense of $484,200, discounted at a rate of 8%, under a full-payout lease for a period of 6 years after which the firm would have an ownership right. Thereafter, for the remaining life of the computer, the company would have a significant additional savings. The selection of the RCA computer was to duplicate the same computer currently in use and to facilitate backing up the online system with the same machine in case

of emergency. Ironically, however, RCA was to announce its withdrawal from general purpose computer business a few months after the report was submitted.

The system development cost of $1,215,000 consisted mostly of salaries paid to programmers and system analysts over a two-year period. However, the labor would be expended by employees currently on the payroll and therefore the implementation would not add an incremental out-of-pocket labor cost. The actual incremental costs of the system would be $3,019,400 in capitalized expenditure over 8 years, an estimated life of the system. They included costs of computer hardware, remodeling, office rooms, system installation, and purchase of furniture.

On the other hand, the new system was expected to realize net annual savings of $1,166,808. This was achieved by a net reduction of 79 employees with an average wage rate of $4.75 per hour in Customer Relations Department, and 14 keypunch operators with an average rate of $3.20 per hour and one control clerk with a rate of $4.97 per hour in the data processing center. In general, the hourly rate was increased by 35% to cover fringe benefits. This reduction in force will later be discussed in detail.

On the basis of cash flows without discounting, the initial investment was recovered by annual savings in 3.6 years. This payoff period became approximately 4.5 years when the annual cash flows were discounted at a rate of 8%, the rate used by the company to evaluate all capital projects.

In August 1971, the system study group presented to top management a proposal to install the on-line system accompanied by the technical and economic feasibility studies discussed previously. Top management was sufficiently impressed by the the profitability of the proposed system. They were equally impressed by non-economic advantages, particularly by the following improvements in customer services:

1. The customer will follow a simpler procedure and have a quicker response to the call because of the use of only one telephone number for all customer calls.
2. The business representative will respond to a customer call faster because of the use of the online customer file and the instant verification of keyed in data by an edit program.
3. The new system will respond to emergency orders promptly. When they are received by the business representative, they will be automatically transmitted to respective field service stations and printed out by on-line printers.
4. Under the existing system many duplicate orders are created because it is virtually impossible to manually match new orders against previously received orders. These duplicate orders will be eliminated under the new system by having the computer match all new orders against logged pending orders when the new orders are entered from the terminal.

The breakdown of 94 people being reduced was as follows:

1. Customer Service Departments

a. Business Representatives	51 persons
b. Business Representative Trainees	3
c. Clerks in Memo Group	6

d. Review and Dispatch Group	25
e. Control Group	1
f. Telephone Exchange Group	3
g. Contingency Staff (increase)	(10)
	79

2. Data Processing Center

a. Keypunch Operators	14 persons
b. Control Clerk	1
	15

The reduction of 51 Business Representatives was expected from a more efficient use of personnel by improved telephone call processing, reduced time in retrieving the customer premise record, and the elimination of the manual preparation of the order form. The reduction of 25 clerks in Sales Division would be expected by the elimination of functions related to the manual processing of pending order forms, reviewing and batching of completed orders, processing of unposted order memos, teletyping of emergency orders, and handling of the present card file used for customer master information. The reduction of 3 telephone switchboard operators is the result of replacing the existing 23 telephone numbers--one for each of 22 customer stations plus one for emergency service--with one telephone number. The contingency staff of 10 people would be created to fill in the positions of business representatives being absent or on break to fully use the new system.

At the data processing center, the existing system required 14 operators to keypunch data on order forms onto IBM cards that were used to post the data on tape files at the end of the day. These people would not be needed because business representatives would key in the data directly into an online transaction file through their terminals. The

elimination of batch posting of customer orders and associated processing would also help reduce one of the control clerks.

The reduction of these employees was the greatest concern of top management. The task force estimated that the main part of the reduction would be absorbed by natural attritions during the system development phase expected to last two years, on the basis of the current annual turnovers of about 50 employees in Sales Division and about 9 keypunch operators in the data processing center. Further, early retirements and reassignments of employees to other areas in need of additional help could accelerate the phasing out process. Thus, the reduction of 94 employees was considered to pose no particular problem to the company.

Implementation of the New System

In the fall of 1971, the proposal was accepted by the top management and a system planning team was organized with the following personnel to analyze the existing system and design a new system:

7 programmer/analysts
1 method and procedure specialist
6 members of Customer Relations Department
1 member of Service Department

About the same time, September 17 to be exact, RCA announced that it was departing from general purpose computer business. The sudden development concerning RCA computers did not affect the decision made by top management on the use of the on-line system, but it forced the system study group to select alternative computers to replace the two RCA computers, one currently in use and the other to be installed for the online system. Subsequently, decisions were made to replace the existing computer with an IBM 370/155 in the following spring and to add an IBM 370/145 when

the cnline system became operational. It was planned that the 155 would be used for the online system, and the 145 would be used for batch processing but be switched to back up the 155 in emergency. To control messages using common data bases, two IBM data base management systems were compared; these were IMS and CICS. CICS appeared to meet most requirements of the online system under consideration while IMS seemed to offer many more features than required by the system. In addition, a more complex method of designing data bases, a higher overhead memory requirement, and a higher lease cost required by IMS than by CICS convinced the system study group to install CICS to handle the online system's messages.

The development work lasted a little over two years during which various modifications were made in the original design. In the summer of 1972, management made a formal announcement to the entire employees of the company on the plan to develop the online customer service system, and held a special meeting of the employees of Sales Division to emphasize that the new system was essential for the long needed improvement in processing customers calls, and that no employee would be fired or laid off on account of the system conversion.

From the fall of 1972 through the spring of 1973, the training materials and standard procedures of the new system were developed. In the summer of 1973, the first group of 20 business representatives was placed in the two-month training program, that was followed by three more groups during the ensuing months lasting through the spring of 1974. Meanwhile, arrangements were made for voluntary early retirements and

the transfers of some of the older business representatives to other jobs in the same division or other divisions.

By the early summer of 1974, the installation of various new hardware and the development of new programs were completed. Subsequently, the new system staffed by 20 business representatives was placed in test operation in parallel with the old system for three months during which a number of errors in computer programs were corrected. In October 1974, the new system was placed in full operation completely replacing the old one.

In the new system business representatives were divided into four groups of 20 people each under four supervisors. These groups occupied an L-shaped floor space with a glass-paneled section in the corner. Each wing of the L-shaped floor was occupied by two groups in tandeum. Members of each group sat in five rows of four people facing abreast the glass-paneled section. This seating arrangement was a radical departure from the previous arrangement where seven people sat around a circular table. The glass paneled section called the control room contained a machine that monitored telephone calls and indicated through the light bulbs on its console the number of customer calls in queue to be processed, the number of calls currently being processed, and the status of each station regarding whether it was switched on and processing a call or waiting for a new call or not switched on.

Post Implementation Observation

By July 1975, the online order processing system had been operating nearly nine months during which new application modules had been added.

Meanwhile, the number of daily calls processed by the system had gradually increased from 7,000, to as many as 8,500 in May. To the bewilderment of everyone concerned, this increase seemed to have little effect on the number of telephone calls waiting in queue. A rationale given to the unchanged length of the queue was that more customers became impatient because of a longer waiting time and left the queue under the previous system than under the new system.

Towards the end of June 1975, there was a surge in number of customer calls. As a result, almost 10,000 calls were processed daily. The surge was caused by a greater number of inquiries about June bills received by customers in budget payment plan. These bills for the last month of the budget payment period were suddenly increased to compensate the accumulated deficits in payments created by two unforeseen events: (1) the spring of 1975 had been exceptionally cold, forcing most families to consume a much greater amount of gas than they had realized, and (2) the substantial rate increase approved by the state a few months earlier had been incorporated in the bill. The suddent increase in the amount of a bill also contributed to a surge of delinquent accounts that had hitherto been slowly but steadily increasing because of the economic recession that started 1974. Almost 15% of the total customer calls were accounted for the inquiries about bills or requests for an extension in payment date.

In July 1975, a survey was conducted to find the attitudes of business representatives toward the new system. Most of them had a stronger sense of accomplishment under the new system because of the system's ability to handle as many as 10,000 calls a day. But they

felt a strong psychological pressure to keep up with customer calls because of machine paced processing. Because of this, they thought that the online system was much more tiring to work with than the manual system.

Some of the business representatives were critical of the new system in that they were completely dependent on equipment and that the response time to an inquiry was too sensitive to the workload at the moment. The response to a request at the terminal was about 5 second in normal periods, but it quickly deteriorated with an increasing load, taking as long as 30 seconds in busy periods of days when a call load of around 10,000 was experienced. Thirty seconds were too long a time to look at a blank CRT screen in anticipation of a message to be displayed at any moment. As a result, many of them considered a system with a slow but predictable response time more desirable than a system with a fast but unpredictable response time such as the new system, and thought the old manual system much more attractive than the new system in this regard.

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Table 1. Cost/Benefit Analysis of the Proposed Online System

I. Capitalized Facility Costs		
1. Computer Equipment Costs		
a. Computer Mainframe	$2,238,400	
b. Disk Packs (20 Units @ $1,000)	20,000	
Total Computer Equipment Cost		$2,258,400
2. Installation Costs		
a. Telephone Equipment	$ 20,000	
b. Terminal Equipment	40,000	
c. Computer Mainframe	18,000	
d. Conduit and Electrical Wiring	44,000	
Total Installation Cost		$ 112,000
3. Remodelling Costs		
a. Customer Service Department	$ 74,000	
b. Data Processing Center	500,000	
Total Remodelling Cost		$ 574,000
4. Other Capital Costs (Customer Service Department)		
a. Furniture	$ 55,000	
b. Training Equipment	10,000	
Total Other Costs		$ 65,000
Total Capitalized Cost		$3,019,400
II. System Development and Implementation Labor Costs		
1. Customer Service Department		
a. System Design, Documentation and Testing	$ 160,000	
b. Training (180 Employees @ 60 hours each)	70,000	
Total Customer Service Department Labor		$ 230,000
2. Information Systems Department		
a. System Analysis and Design	$ 419,000	
b. Program Development	358,000	
c. Keypunch and Clerical	43,000	
d. Conversion and Implementation	87,000	
e. Testing	12,000	
f. Past Implementation Study	43,000	
Total Information Systems Department		$ 962,000
3. Field Service Department		
a. Training		23,000
Total System Development and Implementation Cost		$1,215,000

Table 1 (cont.)

III. Annual Operating Costs		
1. Decrease in Labor Costs		
a. Customer Service Department	$1,053,000CR	
b. Data Processing Center	113,000CR	
Total Decrease in Labor Costs		$1,186,000CR
2. Decrease in Supplies and Equipment Costs		
a. Forms Costs	$ 43,000CR	
b. Telephone Costs	58,000CR	
c. Teletype Costs	5,000CR	
d. Keypunch Rental Costs	12,000CR	
e. Microfilm Costs (COM)	14,000	
Total Decrease in Supplies Costs		$ 104,000CR
3. Increase in Computer Costs		
a. Computer Maintenance Costs	$ 79,692	
b. Sales and Personal Property Taxes[2]	43,500	
Total Increase in Computer Costs		$ 123,192
Net Decrease in Annual Operating Costs		$1,166,808CR

Note: 1. This is the present value of an annual lease payment of $484,200 for 6 years, discounted at a rate of 8%.

2. The sum of an average annual sales tax and an estimated and personal property tax paid over six years is averaged over a system life of eight years.

Figure 2. Call Load, Work Force, and Schedule of Breaks

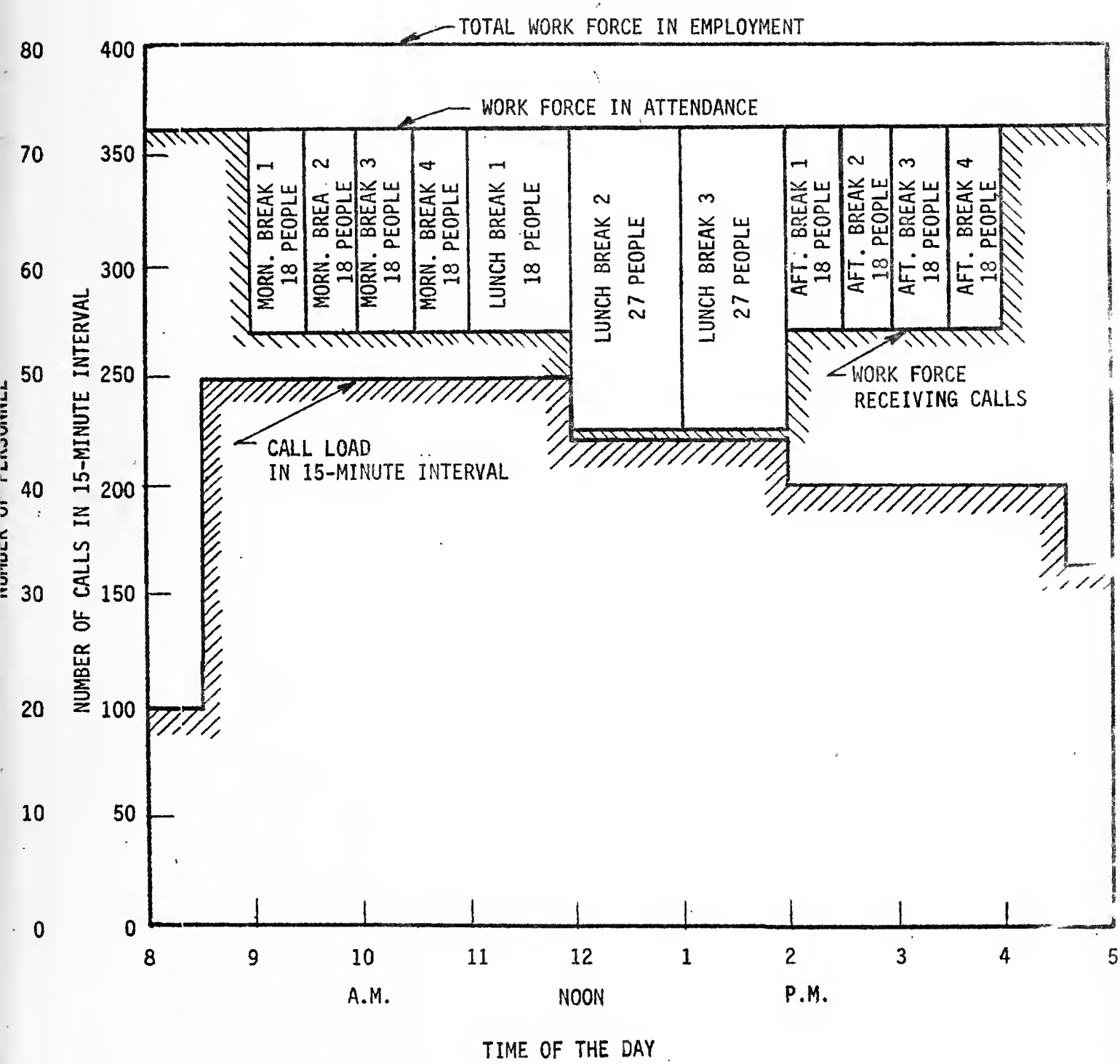

Figure 1. Daily Call Load
on Mondays during 1970