AN EVALUATION OF ALTERNATIVES FOR PROCESSING OF ADMINISTRATIVE PAY VOUCHERS

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Abstract

This paper describes a simulation model of the Accounting and Finance Office processing of vouchers filed for travel reimbursement. The system is explained in detail and the components of the Q-GERT simulation model are described. The model is currently under evaluation by the Accounting and Finance Office for use as a manpower planning tool.

Keywords - simulation, Q-GERT, manpower planning.

INTRODUCTION

The filing of vouchers for payment of travel claims has been in practice by uniformed and civilian members since funds were first set aside to support an army. Although a strict historical account of the evolution of methods used to pay travel claims has not been maintained, it is generally agreed that the first travel claims were simply receipts from merchants, innkeepers, blacksmiths, etc. that the military traveler collected during his official travels and submitted to the paymaster later for reimbursement. The early regulations for filing and subsequent payment of travel claims were relatively uncomplicated and straightforward. A paymaster had simply to determine what was just and fair and reimburse the traveler accordingly.

Such simplicity is no longer the rule for payment of travel claims. Within the Department of Defense (DoD) the Accounting and Finance Office (AFO) at each installation is responsible for seeing that travel claims against the Government are paid. The travel and transportation allowances authorized DoD members and are contained in the Joint Travel Regulatations (JTR's). Should a situation arise that is not covered in the JTR and the local AFO cannot determine proper action, then the situation is forwarded through channels to the Comptroller General for a final decision. Such an action then sets policy for use in similar situations at other installations. In addition to the JTR, personnel in the AFO must comply with respective services' regulations and manuals. Within the Air Force, primary guidance is provided through Air Force Regulation 177-103. Other regulations offer secondary guidance. The volumes of regulations, procedures, comptroller decisions, etc. prompted one AFO worker to make a statement that might contain a hint of longing for less complexity when he said, "We have gone from just and fair to a highly complicated set of rules."

At Wright-Patterson Air Force Base (W-PAFB) the functions concerning financial transactions are within the Accounting and Finance Office (ACF) of the 2750th Air Base Wing (ABW). The processing of travel payments is handled by the Travel Section in ACFT. ACFT is not only responsible for the processing of travel vouchers, it is also responsible for keeping travel records for every traveler. These responsibilities are divided between two subsections of ACFT: Accounting (ACFTA) and Computation (ACFTT).

Within ACFTT is where the calculations are performed on a travel voucher to determine the authorized reimbursement for a traveler. The complexity of figuring reimbursement for a trip dictates that the personnel performing the calculations be highly trained and knowledgeable of the various regulations. By regulation, vouchers must be processed within three workdays of receipt.

ACF management often finds the task of obtaining and retaining qualified people to work in ACFTT a difficult one. The work of processing vouchers is hard and sometimes unrewarding. The work environment itself was cited as being the best of its kind in the Air Force, but the pleasant surroundings are often offset by the high volume of incoming vouchers and shortage of people. In time past, the three-day standard has not been met. This not only causes a violation of regulation, but creates customer/traveler dissatisfaction and

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increases the job pressures of ACFTT personnel.

One reason for late voucher processing has been the absence of a formal procedure for tracking vouchers through ACFT. The vouchers were marked with the Julian date and put into an in-basket to wait for processing, with no close monitoring of date-due-out of individual vouchers. With over 70,000 incoming vouchers a year, the ACF management recognized that a method had to be developed which would not only enable close monitoring of incoming vouchers, but which would also give a measure of output in some form other than numbers of vouchers processed.

The method developed was the Point System. Incoming vouchers are evaluated by an experienced supervisor according to complexity and each voucher is assigned a point value between 0.5 and 5.0, based on that complexity. The vouchers are then marked with point value and Julian date and put into the to-be-processed basket. Each morning a work section leader pulls the vouchers needing processing and assigns them to the personnel who will make the necessary calculations (computers). Once the vouchers are completed by the computers, they are given to the auditors for checking of accuracy. When the auditors are finished, the voucher is considered processed, and is sent to ACFTA for check processing and payment.

The Point System was devised based on the average time it takes an adequately trained computer and auditor to process a voucher. A computer should be able to process one point every fifteen minutes and an auditor should do two points in the same time. Thus, an output standard is set at four points per hour for a computer and eight points per hour for an auditor. Under the Point System each worker keeps a daily record of productive time (processing vouchers) and nonproductive time (filing, telephone, counter, training, etc.) along with the number of points processed in the productive time available. Productive time available multiplied by the standard of 4 or 8 points per hour sets the number of points that person should have processed. When the actual points processed are divided by the number of points that person should have processed, the worker's operating efficiency is determined. This gives management a method for tracking vouchers (counted daily and recorded) and for measuring the performance of the available work force.

The Point System had helped ACF management to better manage available voucher workload and the available ACFTT work force. But as an aid to forecasting personnel requirements, the Point System is rather limited. With 13 computers and 6 auditors assigned at the time of this research, a considerable amount of statistical data must be collected on vouchers (number and type), computers (productive time and compute speed), and auditors (productive time, compute and audit speed). This data then requires statistical analysis and tests to determine what figures are valid for projecting personnel requirements. ACF management can use an overall average of speeds and times, but this type of "back-of-the-envelope" modeling is limited.

Because of the limited ability to forecast manpower requirements within ACFTT, we decided to undertake this project. The specific problem addressed was: Can a model be developed that ACF management could use to forecast manpower requirements based on numbers of incoming vouchers and the Point System? The goal was to produce a model that could be turned over to ACF to be used to justify manpower changes.

MODEL COMPONENTS

In this section the various subsections of the model developed will be described.

Timing Circuit

The function of this subsystem is to control the timing and duration of the simulation run. However, it must also control the start-up conditions, the initial arrival of personnel and vouchers, and the assignment of personnel to customer service. In addition, this sybsystem must collect statistics on the daily activities.

The timing of this simulation is in hours and fractions of hours. The duration of the simulation matches our data collection period, which was 65 workdays or 1560 hours. This duration figure must also consider the start-up conditions of the system and the collection of statistics on the last day. Therefore, 14.5 hours were added to the 1560 hours for a simulated run of 1574.5 hours.

The start-up conditions have to be controlled by the timing circuit due to their one-time occurrence at the beginning of the simulation. The system we are modeling is in being; therefore our model should not start up empty. The insertion of vouchers into the queues represents our effort to control the start-up and ensure a quicker transition to a steady state. The vouchers will be waiting from the prior day close of business for the arrival of personnel on the first duty.

Under normal operations, when personnel arrive, two individuals are assigned to the counter. Our counter assignments are made based on individual historical trends and are controlled by the timing circuit. The timing circuit also controls the initial arrival of personnel to ensure that the counter assignments are made prior to personnel arrival.

Once personnel arrive for work, a four-hour time lapse occurs until the arrival of vouchers. This time lapse is a compromise position with the real world system. As stated earlier, the vouchers arrive at differing times throughout the eight-hour workday. We feel a once-a-day mass arrival pattern will closely approximate the average daily queue waiting times. Under the real system, vouchers can be brought from the counter to the workers many times during a day, depending on counter activity. Our timing circuit controls the initial voucher quantity with a subtiming circuit controlling each day's arrivals thereafter.

The next major activity on the timing circuit is the daily collection of system attributes. Since no civilian overtime was allowed during our 90-day data collection on the actual system, and because military overtime amounted to no more than 1.5 hours, we felt that data collection in the simulated system at 1800 hours would suffice. The statistics collected at this time include vouchers processed, vouchers points processed, and the actual number of vouchers waiting in the "to compute" and the "to audit" queues. This statistic collection method allowed us to measure each day's activity, and in the validation step we were able to test our models against the real system. Following this collection point, our system is idle overnight until 0800 hours the next day, when the counter assignments are made for that day.

Voucher Arrivals

The voucher arrival circuit is keyed by the main timing circuit. The arrival circuit then obtains a random sample of the mail arrivals. The voucher arrival circuit then decrements itself by one as it releases each voucher which arrives. The decrementing process parallels the mark-review-assign process in the actual system. Unlike the real system, the simulated system places the voucher instantly into the "to compute" queue.

Personnel Arrival

This circuit is keyed every 24 hours by the main timing circuit. For each of the 13 computers and 6 auditors, it is necessary to determine who is available for duty. Then a sample of productive time is drawn for each computer. Samples of productive compute and productive audit time are drawn for each auditor. A sample of processing speed is assigned to each available individual. Finally, two individuals are selected to work the counter.

Compute Process

The compute time for a given voucher computed by a given computer can be calculated as:

Processing time = voucher point value / individual processing speed

In this model the processing time is computed each time a voucher and computer are matched and the result is subtracted from that worker's remaining productive time. If additional productive time remains, then the computer returns to the queue for additional voucher processing. A computed voucher can take one of three paths based on the probabilities we determined from ACFTT data. The first path, for vouchers with all required information, is to go on to the to-be-audited queue. Vouchers with missing information may be suspensed, if only a minor piece of information is missing, or returned to the traveler.

Audit Process

Processing time for the auditors is computed using a formula similar to that used to determine computer processing time. As with the computers, the time it takes an auditor to process a voucher is subtracted from the available productive time. If there is productive time remaining, then the auditor is sent back to continue processing. Computation mistakes, if any, found by the auditor are corrected and the voucher is routed out of the system.

User Functions

User functions are employed to model the following processes:

1. System start-up conditions
2. Selection of individuals to work the counter
3. Daily sample of worker arrivals
4. Computers' daily productive times and work speeds
5. Auditors' daily productive time and work speeds
6. Daily statistical collection

Implementation Note

The implementation of the Q-GERT language on the AFIT HARRIS 500 computer allows for a maximum of 850 transactions to be in the modeled system at one time. This presented a problem, since at one time the real system contained 882 vouchers. In order to overcome this problem and to allow our model to parallel the real system as closely as possible, we divided the arrivals, remaining voucher quantities, and individual productive time by two. We then multiplied our simulation outputs by two to determine the simulated performance of the actual ACFTT system.

DATA COLLECTION AND ANALYSIS

Data required for this model falls into one of two areas, voucher or personnel. Voucher data required are: the number of vouchers received, processed, returned, suspensed, and remaining, as well as the total point value received and processed. The personnel data required are: processing speeds, productive times, and availability.

We elected to collect our voucher data sample by selecting a random month from within each quarter of a year. After consulting a random number table the months of March, April, September, and December were selected. Complete data on voucher counts were obtained for September and December of 1981 and March and April of 1982. Because of the large number of vouchers involved (over 200 per day) the data on voucher points was collected only for four, randomly selected days within each month.

The data sample for personnel was collected for the three most recent months for which data were available. We felt that this would yield data most representative of the currently assigned personnel. Since auditors can both audit and compute vouchers, separate data was collected on both processing speeds.

Alternatives for Processing Pay Vouchers (continued)

The data on daily number of vouchers received was determined to be normally distributed. For purposes of validation, we also analyzed the daily number of vouchers on hand, which was determined to be lognormally distributed. See Table 1. The distribution of points per voucher was incorporated into the model as an empirical discrete distribution, as shown in Table 2. The percentage of suspensed (2%) and returned (8%) vouchers was also incorporated into the model as an empirical discrete distribution.

The personnel processing speeds were analyzed on an individual by individual basis, with lognormal distribution parameters determined for each individual. Productive time is obviously trapped between zero and eight hours per day. After transforming the data by subtracting it from eight, it was determined to be lognormally distributed. The computation speed for auditors performing that secondary task proved troublesome to characterize. We elected to use an empirical distribution to model this. Finally, the data on personnel availability was reduced to a Boolean case where we consider only the probability that a person is available on a given day.

Table 1

Voucher Counts

	Mean	Minimum	Maximum	Standard Deviation
Arrivals				
All data	217.1	22.0	499.0	95.3
Highest arrival month	257.5	170.0	499.0	78.5
Lowest arrival month	160.2	22.0	499.0	97.3
On hand				
All data	537.1	88.0	1114.0	255.2
Highest arrival month	815.9	560.0	1114.0	201.4
Lowest arrival month	314.5	88.0	479.0	96.9

Table 2

Voucher Point Distribution

Voucher Point Value	Count	Percent of Total
0.5	258	11.7
1.0	1562	70.6
2.0	294	13.3
3.0	73	3.3
4.0	9	.4
5.0	15	.7
Total	2211	100.0

These data are incorporated into the model via parameter cards or as data in the FORTRAN user functions.

VERIFICATION AND VALIDATION

The model obtained face validity through the process of a detailed walk-through of program logic with the supervisor of ACFTT. Validation was attempted by comparing the values of important state variables in the simulation (such as numbers of vouchers in the "to compute" and "to audit" queues and number of vouchers and points processed) to actual system values observed in the data collection period. When we were convinced of the validity of the model, experiments commenced.

RESULTS

Results for a typical simulation run are summarized in Table 3. The average queue size is primarily useful for validating that the model behavior closely approximates the actual system behavior. Recall that regulation requires that vouchers be processed within three days (actually day of receipt plus two). Clearly the requirement that every voucher be processed in no more than three days is a stricter requirement than the same three-day standard applied in an average sense. For economy of manpower, the criteria for adequate performance of the system has been taken as the average queue time of vouchers not exceeding 52.5 hours. The figure 52.5 accounts for the time between the start of the day and the mass arrival of vouchers in the simulated system. Using this criteria for success, simulation runs using various workload and work force parameters can be evaluated. For example, for cases where the three-day standard is not being met, the effects of adding additional computers or auditors can be observed.

A possible policy analysis application of the model has been considered. It would be possible, using this model, to evaluate policy changes such as the effects of changing the Joint Travel Regulations to simplify reimbursement rules. If an estimate of the distribution of point values from incoming vouchers can be made, then possible reductions in manpower under the new policy can be evaluated.

Table 3

Simulation Results

Average Daily Vouchers Processed	Average Daily Points Processed	Average Daily To-Compute Queue	Average Daily To-Audit Queue	Average Daily Vouchers Remaining
221	233	130	445	575

Average Daily Hours in To-Compute Queue	Average Daily Hours in To-Audit Queue	Average Daily Hours in Queues
7.3	29.9	37.7

CONCLUSIONS AND RECOMMENDATIONS

The ultimate goal of this project was to provide a tool for use by the computation branch within the Wright-Patterson AFB Accounting and Finance Office. Historical data from the computation branch were used to model, in some detail, the voucher computation workload and personnel resources of this system. The model allows for evaluation of a specified work force and a specified workload to determine if the required three-day maximum processing standard will be met. The model is being evaluated by the Accounting and Finance Office as a tool to aid in rational decision-making on manning levels.