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COMPARATIVE REVIEW OF SINGLE-LINE AND MULTILINE OPTICAL 1/1
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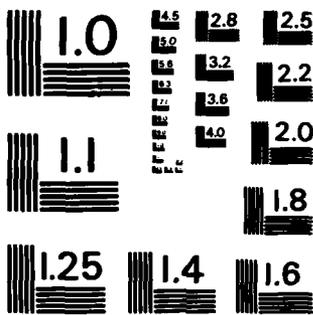
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REPORT BY THE U.S.

General Accounting Office

AD-A148 042

Comparative Review Of Single-Line And Multiline Optical Character Readers Used In Mail Processing

In a program to automate mail processing, the U.S. Postal Service is buying single-line read optical character readers. The Service decided against buying multiline optical character readers, a more advanced technology, primarily because of cost considerations. A switch to multiline optical character readers at this time would mean a possible 3- or 4-year delay of further Service automation and could result in a loss of savings.

As requested by the Chairmen of the House Committee on Post Office and Civil Service and its Subcommittees on Postal Operations and Services and Postal Personnel and Modernization, GAO compared the costs and performances of the two types of readers.

GAO found that each of the two readers has advantages over the other, but the key to which one the Postal Service should buy is the eventual level of mailer use of the nine-digit ZIP Code (ZIP + 4). The extent of ZIP + 4 usage that will develop is still uncertain.

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**UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548**

**GENERAL GOVERNMENT
DIVISION**

B-215132

The Honorable William D. Ford
Chairman, Committee on Post
Office and Civil Service
House of Representatives

The Honorable Robert Garcia
Chairman, Subcommittee on Postal
Operations and Services
Committee on Post Office and
Civil Service
House of Representatives

The Honorable Mickey Leland
Chairman, Subcommittee on Postal
Personnel and Modernization
Committee on Post Office and
Civil Service
House of Representatives

In your joint letter dated October 5, 1983, and in our subsequent discussions with your offices, we were asked to conduct a comparative analysis of single-line optical character readers (OCRs) and multiline OCRs used in mail processing. You were concerned about the soundness of the Postal Service's decision to use single-line read OCRs instead of multiline read OCRs.

In Phase I of the Service's program to automate mail processing, the Service contracted for and is currently deploying 252 OCRs, all single-line equipment. Preparatory to Phase II of the acquisition, the Service received proposals from four U.S. manufacturers for 403 additional single-line OCRs. These four manufacturers are Burroughs Corporation; ElectroCom Automation, Incorporated; Pitney Bowes; and Recognition Equipment, Incorporated (REI). At the time of our field work, the Service expected to award a contract to one of these manufacturers in July 1984. The contract was awarded on July 10 to ElectroCom Automation, Incorporated.

We found that the multiline OCR performs better than the single-line OCR at all ZIP + 4 usage levels tested. That is, it will place a nine-digit bar code on a greater percentage of machinable First-Class Mail than will the single-line OCR. This difference is due to the multiline OCR's capability of bar coding a mail piece to nine digits without a nine-digit ZIP Code

on the mail piece. Although both machines produce substantial work-year savings over a mechanical system, the multiline OCR's performance advantage over the single-line results in greater work-year savings by the multiline machine. On the other hand, we believe the single-line machine would cost less to buy and maintain than the multiline machine.

In the final analysis, the eventual level of ZIP + 4 usage by mailers will determine whether the Postal Service should switch to multiline read OCRs; that is, the extent of work-year savings is directly related to ZIP + 4 usage (see pp. 6 and 7 of app. I). ZIP + 4 was instituted in October 1983. As of late May 1984, businesses had been very slow to adopt ZIP + 4; the Service had achieved less than 25 percent of its ZIP + 4 volume goal for fiscal year 1984. However, since the program was only 8 months old in May 1984, the usage achieved by then should not be used to infer that the program will not ultimately succeed. The extent of ZIP + 4 usage that will develop is still uncertain. (See pp. 17 to 19 of app. I.)

A switch to multiline OCRs would delay the Phase II automation possibly 3 to 4 years and could result in a loss of savings. The amount of savings lost would be directly related to the level of ZIP + 4 usage; that is, the greater the ZIP + 4 usage, the greater the amount of savings that would be lost by delaying the Phase II automation.

It might be possible to have a multiline system without a delay in the Service's automation program by designing and building a retrofit kit to convert single-line OCRs to multiline. The Service said it will initiate a strategy to ensure that it has the capability to convert single-line OCRs to multiline operation.

These matters are discussed in appendix I to this letter. Postal Service and REI comments on our draft report are included as appendixes II and III, respectively.

The Service took issue with only one aspect of our draft report. It contended that our estimate of a \$45,000 cost difference between the single-line and multiline OCRs seemed low. The Service said it believed the difference would be "more like \$200,000." We believe the difference between the Service's estimate and ours is due to differences in data sources. We believe the data sources we used were the best available.

B-215132

REI said it considered our draft report an accurate comparison of the two types of OCRs. It suggested that several findings be expanded upon for clarity. We expanded our discussion of these findings in the final report.

As arranged with your offices, we are sending copies of this report to the Postmaster General; Burroughs Corporation; ElectroCom Automation, Incorporated; Pitney Bowes; and Recognition Equipment, Incorporated. Copies will also be available to other interested parties on request.

W. J. Anderson

William J. Anderson
Director



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COMPARATIVE REVIEW OF SINGLE-LINE
AND MULTILINE OPTICAL CHARACTER READERS
USED IN MAIL PROCESSING

OBJECTIVE, SCOPE, AND METHODOLOGY

Objective

Our review objective was to develop comparative cost and performance information about single-line read and multiline read optical character readers (OCRs) which would aid the House Post Office and Civil Service Committee in its deliberations on the Postal Service's planned Phase II acquisition of single-line read OCRs.

Methodology

To do this we

- compiled comparative information (single-line read OCRs versus multiline read OCRs) on (a) machine performance, (b) purchase and maintenance costs, and (c) work-year savings at various ZIP + 4 usage rates;
- estimated a loss of savings which could result from a delay in automation if the Service switched to multiline OCRs for Phase II; and
- inquired into the extent to which mailers were converting to ZIP + 4.

We interviewed and obtained data from Service officials and staff (headquarters and field), the four OCR manufacturers competing for the Phase II contract, two foreign OCR manufacturers (Elettronica San Giorgio of Italy and Telefunken of Germany), and business associations¹ whose memberships included large-volume mailers. We observed OCR operations in a postal facility at each of the following locations: Chicago, north suburban Chicago, Philadelphia, and Dallas. These were four of the five facilities in the United States using both single-line and multiline OCRs, both of which we sought to observe. We examined OCR operational and performance test data. We developed a computerized mail flow model to estimate the number of multiline read OCRs that would be needed and the clerk-year savings that

¹The associations which provided data: American Bankers Association, American Council of Life Insurance, American Retail Federation, Council of Public Utility Mailers of American Gas Association & Edison Electric Institute, Fulfillment Management Association, and the United States Telephone Association.

would be achieved if multiline OCRs were used in Phase II rather than single-line OCRs. We were assisted in our work by National Bureau of Standards engineers. Our work was performed in accordance with generally accepted government auditing standards.

Constraints on our work

Our work was hampered by several constraints:

- Because of time constraints, we were unable to verify the data obtained from the Service and the equipment manufacturers.
- Because the two machines we attempted to compare--the single-line OCR to be mass-produced in Phase II and a production model multiline OCR designed for processing U.S. mail--had not been manufactured, we were unable to compare actual data on purchase cost, operating performance, and maintenance cost. Much of the data on which we based our comparisons was obtained from experience with OCRs that did exist (Phase I single-line OCRs and five preproduction model multiline OCRs) and from Postal Service and manufacturer estimates.
- Because only one make of multiline OCR (REI) had been produced for use with U.S. mail, there was a dearth of hard data on multiline technology in the postal environment. Although five REI OCRs were being used by the Service, they were preproduction models whose costs and operating and maintenance experience could not be reliably projected to production models.

HOW SINGLE-LINE AND MULTILINE OCRs DIFFER

OCRs, the automated mail sorting machines the Service is buying for use with the nine-digit ZIP Code (ZIP + 4), read the address and ZIP Code on the mail piece (they read from the bottom line up) and print on the mail piece a bar code representing the ZIP Code. At the destination post office, bar code sorters (BCSs) read the bar code and sort the mail directly to carrier routes.

The single-line read OCR can process at least one line of the address block (the city, state, and ZIP Code line) and correctly bar code a five- or nine-digit ZIP Code, whichever code is in the address.

The multiline OCR can process at least four lines of the address block and, depending on the geographic coverage of an internal nine-digit ZIP Code directory, correctly bar code a nine-digit ZIP Code on the mail piece. Using the address

information on the mail piece, it searches the directory and obtains the nine-digit ZIP Code. The multiline OCR needs no ZIP Code on the mail piece if the address is in the machine's internal directory.

POSTAL SERVICE'S JUSTIFICATION FOR
BUYING SINGLE-LINE OCRs IN PHASE II

In correspondence with the House Post Office and Civil Service Committee, the Postal Service said it had compared single-line and multiline OCRs and had decided to buy single-line OCRs in Phase II because of the following considerations:

- Multiline machines would cost at least \$200,000 more per machine than single-line machines, according to the manufacturer's estimates.
- Multiline machines would cost significantly more to maintain.
- Buying multiline machines would require a 2- to 3-year delay in Phase II automation and result in a substantial loss of savings. (In interviews later, Service officials revised their estimate of the delay at about 45 months.)
- Multiline machines would only marginally increase clerk-labor savings over single-line machines as ZIP + 4 usage grew to the 90-percent level expected by the Service. This increase would be too small to justify the added cost of the multiline machines.

The Service presented to the Committee a graphical comparison of savings that it said could be achieved through the use of single-line and multiline OCRs with ZIP + 4.

Although dollar amounts were portrayed graphically, Service officials told us that most of the savings curve for the multiline OCR had been plotted rather subjectively because essential performance data were nonexistent and that the graph had been intended to show a concept rather than an actual dollar savings estimate based on a detailed savings analysis. The conceptual message intended was as stated above--that as ZIP + 4 usage rose to higher levels, the multiline OCR would provide only a marginal increase in savings over the single-line OCR. The officials said their savings comparison showed that the Service will have made a reasonable OCR choice if ZIP + 4 usage climbs to 60 percent or higher.

With the aid of computer modeling, we independently examined the relative clerk-labor savings of the two OCR technologies. Our results are presented in the following section.

COMPARING PERFORMANCES OF SINGLE-LINE AND MULTILINE OCRs

Methodology

In comparing performances of single-line and multiline OCRs, we performed a sensitivity analysis to determine the impact of various ZIP + 4 usage rates on the machines' performances--specifically, on the percentage of mail pieces that each type of OCR can bar code to nine digits.

Using computerized models to simulate mail processing operations at the 209 sites that will receive OCRs, we compared work-year savings under two assumed automated systems. One system employed single-line OCRs in both Phases I and II. The other system employed a mix of single-line and multiline OCRs. In the mix, the single-line OCRs were essentially those 252 machines the Service had already purchased under Phase I of its automated program, and the multiline OCRs were the 444 machines we estimated would be needed to replace the 403 single-line OCRs planned for Phase II if the Service switched to multiline OCRs for Phase II. We used work-year savings as a basis for comparing the performances of single-line and multiline OCRs.

We used assumed performance of the Phase II single-line OCR. We used assumed and actual performances of the REI multiline OCR, since the REI machine was the only existing U.S. mail-oriented multiline machine.

We found that overseas experience with multiline OCRs cannot be projected to U.S. mail processing with confidence because of the significant differences in U.S. and foreign mail mixes and addressing systems. Therefore, we did not use foreign OCR performance data in our comparison.

Assumptions used to construct models

In a January 1984 proposal to the Postal Service Board of Governors, the Service requested approval to purchase 403 single-line OCRs in Phase II of its automation program. (The Board approved the request.) The Service developed its January 1984 proposal by, in part, simulating mail processing operations at a 38-site sample of automation sites (post offices). These simulations followed certain Service assumptions and used mail processing data generated by each of the 38 sites.

We used essentially the same assumptions the Service had used, as well as the same data from the 38 sites, to construct our simulation models. We also added other assumptions necessary to operate our mixed-OCR mail processing system. For example, we assumed certain mail handling procedures within the mixed system (such as the processing of some mail by OCRs

twice²) and certain performance criteria for multiline OCRs (such as a productivity rate of 10,000 letters per staff-hour).³ Using simulation results and statistical projection techniques, we estimated work-year savings for all 209 automation sites. Our simulations, like the Service's, assumed a fully equipped and operational system by 1989.

How ZIP + 4 usage might
affect the performances of
single-line and multiline OCRs

The results of our sensitivity analysis of the impact that various ZIP + 4 usage rates would probably have on the performances of single-line and multiline OCRs are shown in the following table. In the table, the ZIP + 4 usage rates represent the percentage of First-Class, machinable mail which has ZIP + 4 in the address. The bar coding rates represent the percentage of

²The mail would be OCR-processed once at the originating post office and again at the destination post office where the multiline OCR's ability to "look up" ZIP + 4 codes in its internal directory could be beneficially used (see pp. 2 and 3). For our simulations, we assumed that the multiline's internal directory covered only the geographic area which was "local" to each automation site (post office). The five REI multiline OCRs (see p. 2) contain local directories, and, on the basis of discussions with OCR manufacturers, an internal directory that is national in coverage appears impractical at this time.

In commenting on our draft report, REI said that, although a nationwide directory for each multiline OCR is impractical, the directory memory for its multilines could be significantly increased to contain key addresses located in destinating post offices. This, REI said, could significantly increase the amount of mail that multiline OCRs bar code to nine digits at originating post offices. (See p. 23.)

³In commenting informally on our draft report, Service officials said the bar code sorters in our mixed-OCR system would probably experience a lower productivity rate and reject more letters than we assumed in our model. (We assumed no difference in bar code sorter performance between the single-line and mixed-OCR systems.) Service officials believed the nine-digit bar codes that multiline OCRs placed on non-ZIP + 4 addressed letters would be misaligned in some instances because of the two-stage coding that would occur (see footnote 2) and that bar code sorters would have difficulty reading these misaligned bar codes. However, the Service had no data indicating the existence or severity of the problem. Degradation in the performance of bar code sorters would lower work-year savings.

all mail pieces that the OCR can, on the mail's first pass through the machine, imprint with a nine-digit bar code.

Estimated Variations in Average Nine-Digit Bar Coding Rates in Response to Changes in ZIP + 4 Usage

ZIP + 4 usage rates (percent)	Bar coding rates	
	Single-line OCR (percent)	Multiline OCR ^a (percent)
90	61	63
76	51	56
67	45	51
57	38	46
48	32	42
38	26	37
27	18	31

^aThe multiline OCR bar coding rates assume that about 40 percent of the originating mail is local mail and will stay within the area served by the originating office. (The 40-percent estimate is based on data from a Postal Service sampling of 37 automation sites.) If the nine-digit ZIP Code is not present on the mail piece, the multiline OCR can apply a nine-digit ZIP Code to this local mail only.

As shown in the previous table, multiline OCRs appear to perform slightly better than single-line OCRs when there is high ZIP + 4 usage. With low ZIP + 4 usage, multiline OCRs appear to perform significantly better than single-line OCRs. This difference in performance is due to the multiline OCR's capability of bar coding a mail piece to nine digits without a nine-digit ZIP Code on the mail piece.

Comparative work-year savings

The following table shows the number of work-years we estimate the two OCR-based systems would each save the Service annually at various ZIP + 4 usage levels. Again, as pointed out on page 4, the mixed-OCR system includes both single-line and multiline OCRs. The estimates are for both Phases I and II of the Service's automation program and all 209 automation sites.

Estimated Variations in Annual Work-Year Savings
in Response to Changes in ZIP + 4 Usage

<u>ZIP + 4 usage rate (percent)</u>	<u>Estimated annual work-year savings^a</u>		<u>Mixed-OCR system increase over single-line OCR system (percent)</u>
	<u>Single-line OCR system</u>	<u>Mixed-OCR system</u>	
90	20,900	21,800	4
76	16,600	18,900	14
57	13,500	17,300	28
38	11,600	16,700	44

^aOur estimates were developed from a probability (statistical) sample. Each estimate has a measure of precision, or sampling error. At the 95 percent statistical confidence level, the smallest sampling error was about 2,300 work-years; the largest, 4,200 work-years.

As illustrated in the table, at all ZIP + 4 usage levels tested, the mixed system would appear to produce greater work-year savings than the single-line OCR system. However, the estimated savings varied with ZIP + 4 usage rates. The estimated work-year savings difference between the two systems was relatively small when ZIP + 4 usage was high, but widened significantly at the 57 percent usage level.

COMPARISON OF SINGLE-LINE OCR
COSTS WITH MULTILINE COSTS

Our projections indicate that the Service-estimated investment cost (cost of purchase, installation, site and initial depot inventory of spare parts, and miscellaneous expenses) for the Service to procure production multiline OCRs⁴ in Phase II would be about \$353 million, or 17 percent higher than the Service-estimated investment cost of \$302 million for Phase II single-line OCRs. Correspondingly, multiline OCR maintenance costs would probably also be higher than Phase II single-line OCR maintenance costs. However, we do not believe multiline maintenance costs would be as high as the Service has projected.

⁴The standard REI multiline OCR system has two mail transports (mechanical units that the mail is fed through to be read and sorted), while the single-line OCR system has one transport. Because of this difference, we made most of our comparisons on a per-mail-transport basis.

Methodology

We estimated for Phase II single-line and multiline OCRs the costs of purchase, maintenance labor, spare parts, maintenance training, software maintenance, and address directory maintenance. Because data on actual investment and maintenance costs for Phase II single-line and for production multiline OCRs were nonexistent, we developed our estimates from interviews with officials and staff members of the Service and REI, the sole American manufacturer of multiline OCRs. Also, we examined the Service's Phase II single-line OCR cost estimates and an unsolicited proposal which REI submitted to the Service in 1982 for the sale of production units of its multiline OCR.

Assumptions

We developed our comparisons of estimated Phase II single-line and production multiline OCR costs on the assumption that Phase II single-line and REI production multiline OCRs would have the same functional characteristics, capabilities, performance, and basic equipment configurations as single-line OCRs competitively tested by the Service before contract award and REI preproduction OCRs, respectively. Also, we assumed the REI production multiline OCR would be built and installed with (a) the computer subsystem and electronics stored in a cabinet on the mail room floor; (b) peripherals which included two magnetic tape drives, a sealed disk unit, line printer, and CRT terminal; (c) 60 stackers (mail pockets) per mail transport; (d) plug-in printed circuit boards, which would facilitate maintenance; (e) easy to use maintenance diagnostics (computer programs which detect and isolate defective printed circuit boards); (f) a computer the Service could easily maintain; and (g) a vendor developed OCR address directory. We based these assumptions on discussions with Service and REI officials and a review of REI's unsolicited proposal.

Comparison of estimated investment costs

Using REI's purchase price data (which were not gathered in a competitive pricing environment), the Service's Phase II OCR investment cost data, and our simulated mail processing data (see pp. 4 to 5), we computed the estimated investment cost for a Phase II purchase of REI production multiline OCRs. We developed our estimate by computing (a) the number of multiline OCRs the Service would need to fully replace its planned Phase II procurement of single-line OCRs, (b) the transport (single versus dual) and stacker (42 versus 60) configuration that would be needed, and (c) the purchase prices for production multiline OCRs built in the above transport and stacker configurations. On the basis of our computations, we estimated that the total investment cost for a full Phase II procurement of REI

production multiline OCRs would average about \$795,000 per mail transport.⁵ The Service estimated that the investment cost per single-line OCR would be \$750,000. Thus, a comparison of estimated investment costs indicates that the REI multiline per-mail-transport cost would exceed the Service-estimated cost of a single-line OCR by about \$45,000, or about 6 percent.

We estimated that, if the Service fully replaced its planned Phase II procurement of 403 single-line OCRs with multiline OCRs, the Service would need 444 multiline OCR transports.⁶ (We also estimated that the Service would need to buy these 444 transports in a mix of--roughly--108 single-transport and 168 dual-transport multiline OCRs.⁷) Using our estimate of 444 multiline OCR transports and our estimated investment cost of \$795,000 for each production multiline OCR transport, we estimated that the Service's total investment cost for a Phase II procurement of multiline OCRs would be about \$353 million. The Service estimated that its total investment cost

⁵Our analysis indicated that over half of the sites that are scheduled to receive Phase II single-line OCRs would each receive an odd number of multiline OCR transports. Therefore, a full procurement of REI multiline OCRs would require the purchase of both single- and dual-transport multiline OCRs. Also, our discussions with REI officials revealed that, due to the multiline OCR's electronic configuration, a single-transport multiline OCR would have a higher per-mail-transport purchase price than a dual-transport OCR. Consequently, we believe that the average per-mail-transport investment cost for REI multiline OCRs would vary depending on the mix of single- and dual-transport OCRs procured.

⁶We estimated the number of multiline OCR transports needed through our mail processing model work. More multiline than single-line transports would be needed in order to take full advantage of the multiline's ability to internally determine the ZIP + 4 code for locally destined mail. This ability would enable multilines to process mail both originating at and coming into a post office (see footnote 2, p. 5). In contrast, single-line OCRs generally process only mail originating at a post office. The multiline OCR's greater workload, together with mail dispatch schedules, would cause the need for more multiline OCRs. The results of our modeling work showed that the mixed OCR system, which included the 444 multiline OCR transports, would produce greater work-year savings than the single-line OCR system (see table, p. 7).

⁷That is, $108 + (168 \times 2) = 444$ transports.

for a Phase II procurement of single-line OCRs would be about \$302 million. Thus, we estimate that a Phase II procurement of multiline OCRs would be about \$51 million, or about 17 percent, more costly than a Phase II procurement of single-line OCRs.

Comparison of operating labor costs

We believe there would be no significant difference in the per-mail-transport operating labor costs for single-line and REI multiline OCRs. Operating data and information provided by Service officials indicate that staffing levels--current and projected--for the two types of OCRs are comparable. However, since an estimated 41 more multiline OCR transports would be needed than single-line transports, the total operating labor cost would be higher for a Phase II multiline system.

Comparison of estimated maintenance costs

Current multiline OCR maintenance costs: not good indicators of production multiline maintenance costs--The Service concluded, on the basis of actual and projected data, that preproduction multiline OCR maintenance costs are significantly higher than Phase I single-line maintenance costs. On the basis of discussions with Service officials and a review of the Service's data, we agree with the Service's conclusions. However, we found that the Service accords its preproduction multiline OCRs more intensive and expensive maintenance than the Service would provide if the preproduction OCRs were production machines. [For example, whereas substantial quantity discounts were expected to be available to the Service when buying spare parts for the 252 Phase I single-line OCRs the Service was buying, comparable discounts have not been available when buying spare parts for the 5 (dual transport) preproduction multiline OCRs the Service now owns. (See pp. 2 and 3.)]

Further, our review of REI's unsolicited proposal and discussions with REI officials revealed that REI had proposed various modifications (for example, plug-in printed circuit boards and a computer that the Service could easily maintain) which would be incorporated in a production multiline OCR. REI and Service officials agreed that these modifications would probably make the REI production multiline OCR less costly to maintain than the current, preproduction model.

For the above reasons, we believe that current, preproduction multiline OCR maintenance costs are not good indicators of what production multiline OCR maintenance costs would be.

Maintenance labor costs--We believe that per-mail-transport maintenance labor costs for a production multiline OCR would probably be higher than for a single-line OCR, although not

significantly higher. Because of the larger number of multiline OCR transports that would be needed in Phase II than single-line OCR transports, total maintenance labor costs would, therefore, also be higher for a Phase II multiline system.

We asked Postal Service field maintenance personnel for their opinions on the maintenance requirements for the two types of OCRs. Because preproduction multiline and Phase I single-line OCRs at the Postal facilities we visited had per-mail-transport stacker configurations of 30 and 60 pockets, respectively, we asked the maintenance personnel to base their estimates on the assumption that the multiline OCR, like the single-line OCR, would have 60 stackers per mail transport. Although they could not support their positions and they were not unanimous in their opinions, nearly all of them estimated that on a per-mail-transport basis, assuming 60 stackers per transport, the preproduction multiline OCRs would require less maintenance than the Phase I single-line OCRs.

We reviewed available mail processing equipment maintenance records for fiscal years 1983 and 1984 at the postal facilities visited to obtain a perspective of current multiline and single-line OCR maintenance needs. We found that the frequency of unscheduled maintenance to correct breakdowns was much greater for single-line OCRs than for multiline OCRs. However, most of the field maintenance officials we interviewed stated that because of the multiline OCR's greater electronic complexity, its average breakdown repair time was much longer than that of the single-line machine. They said they believed that this longer repair time offset the multiline machine's advantage of fewer breakdowns.

Skill levels of maintenance technicians differ between current single-line and multiline OCRs. The preproduction multiline OCR maintenance is highly complex and, therefore, must be performed by the Service's highest skilled and generally highest paid maintenance technicians. However, Service officials agreed that, if the production multiline OCR were to have board-level maintenance⁸ (as proposed by REI), the maintenance skills that probably would be needed to maintain this OCR would be lower than those needed to maintain the REI preproduction model. Also, they agreed that the maintenance skills that probably would be needed to maintain a production multiline and single-line OCR would be comparable. Therefore, we believe that the production multiline and single-line OCRs could be maintained by maintenance technicians with comparable skills and pay.

⁸Maintenance characterized by identification and replacement of defective modules, as opposed to identification and repair.

We discussed with Service headquarters maintenance officials the maintenance data we had gathered on our field visits and obtained their opinions on the comparative maintenance required for Phase II single-line and REI production multiline OCRs. The officials stated that (a) if the OCR maintenance data we had gathered was accurate and (b) if the contractor could build a quality production multiline OCR in the GAO-assumed configuration (see p. 8), the Service would probably maintain the production multiline OCR in a manner comparable with that of the single-line OCR. That is, it would not use dedicated maintenance⁹ as it does now with the preproduction multiline OCR. The officials estimated that, under the two above conditions, the REI production multiline OCR, because of its additional complexity and parts, would require more maintenance attention than the Phase II single-line OCR. However, they did not believe that, on a per-mail-transport basis, the difference would be significant.

Spare parts costs--Because a multiline OCR has more capabilities than a single-line OCR, it has more parts. Maintenance officials concluded that, as a result of having more parts, spare parts costs for a production multiline OCR would be slightly higher than for a Phase II single-line OCR. Although comparable spare parts usage data were not available, we believe the officials' conclusion is reasonable.

To put spare parts costs in perspective: the Service estimated that annual spare parts costs will amount to about 3 percent of a Phase II single-line OCR investment cost. Using the same percentage factor (3 percent), and assuming that the parts on both OCRs fail at a comparable rate, we estimate that annual per-mail-transport spare parts costs for a production multiline OCR would be about 6 percent higher than for a Phase II single-line OCR. Also, we estimate that the total annual spare parts costs for the GAO-estimated 444 multiline OCR transports would be about 17 percent higher than such costs for the Service's 403 Phase II single-line OCRs. This 17 percent increase is a result of the higher per-transport spare parts cost and the need for 41 additional multiline transports.

Maintenance training costs--According to Service and REI estimates, maintenance training costs for an REI production multiline OCR would be higher than for a Phase II single-line OCR. REI estimated that maintenance training costs for its production multiline OCR would be between 9 and 18 percent higher than for the Phase II single-line OCR. Service maintenance training and support officials estimated that maintenance

⁹The term dedicated maintenance means devoting skilled maintenance technicians to primarily one OCR.

training for an REI production multiline OCR could cost up to 18 percent more than for a Phase II single-line OCR. Because REI and the Service are both familiar with the preproduction multiline OCR, the assumed production model, and OCR maintenance training, we believe their estimates are reasonable.

To put maintenance training costs in perspective: using the Service's estimated Phase II single-line OCR maintenance training costs, we estimated that the one-time cost to train a full complement of skilled maintenance technicians will be about \$31,000 per mail transport. Such a cost for the REI production multiline OCR should be no higher than about \$37,000 per mail transport. However, since the Service would need an estimated 41 more multiline OCR transports than single-line transports, total maintenance training costs for the full Phase II procurement of a multiline OCR system would be about \$3.9 million, or 32 percent, higher than for the planned Phase II single-line procurement.

OCR software maintenance costs--The Service believes that the software maintenance costs for a multiline OCR would be significantly higher than for a Phase II single-line OCR. We agree. Because of the multiline OCR's capability to process at least three more address lines than a single-line OCR can process, the multiline OCR has considerably more computer software. This accounts for its higher software maintenance costs.

At the time of our review, no software maintenance had been performed on the Service's five preproduction multiline OCRs and the Service had not yet contracted for such maintenance. Consequently, the Service could not quantify production multiline OCR software maintenance costs.

OCR address directory maintenance costs--OCR address directory maintenance is the manual and automated updating of address records stored within an OCR's internal directory. Both the single-line and multiline OCR internal directories store city, state, and five-digit ZIP Code information. However, the multiline OCR's internal directory also stores local nine-digit ZIP Code and associated address information (such as local firm names, building names, post office box numbers, and street addresses).

The Service estimated that address directory maintenance costs for the multiline OCR would be significantly higher than for a single-line OCR. We believe the Service's estimate is reasonable because the multiline OCR's internal directory has substantially more address information and maintenance needs than a single-line OCR's internal directory. We compared the average number of address records stored within single-line and

multiline OCRs and found that, for each single-line OCR address record, the multiline OCR had about 34.

To put single-line and multiline OCR address directory maintenance costs in perspective, we attempted to gather some comparative costs. We could not gather single-line OCR costs because the Service had neither exact nor estimated costs regarding single-line OCR address directory maintenance. On the basis of Service planning data, we estimate that the annual per site address directory maintenance costs for a Phase II multiline OCR system would be about \$32,000. Also, we estimate that the total annual address directory maintenance cost for the GAO-estimated 444 multiline OCR transports would be about \$6.7 million.

EFFECTS OF A DELAY IN PHASE II ACQUISITION

A switch from single-line to multiline OCRs for the Phase II purchase would delay the Service's automation efforts, possibly as long as 3 to 4 years. If automation were delayed, savings that would have been available had there been no delay would be forgone. The extent to which businesses used ZIP + 4 would influence both the amount of savings forgone and whether such forgone savings would be recovered after the delay.

Service officials estimated that if, in July 1984, instead of awarding a contract for single-line OCRs, the Service began the necessary actions to buy multiline OCRs for Phase II, Phase II automation would be delayed about 45 months.¹⁰

According to Service officials, the delay would occur because all the steps the Service took to acquire Phase II single-line OCRs would have to be repeated. Also, they said, because of the greater difficulties multiline OCRs inherently present, some steps would take longer to complete, such as developing and evaluating ZIP Code directories tailored to automation sites.

The procurement activities, or steps, outlined by the Service appeared appropriate. But, because of time constraints,

¹⁰In commenting on our draft report, REI said it was unclear why purchase of multiline OCRs would require a 45-month delay, since activities that culminated in the procurement (contract award) of Phase I OCRs took approximately 30 months to complete. (See p. 23.) The Service's estimate of 45 months was based on the estimated time necessary to complete activities that would culminate in the initial delivery of manufactured OCRs rather than in the contract award. (In Phase I, approximately 18 months elapsed between contract award and delivery of the first OCRs.)

we did not assess in depth the time the Service said would be required to complete a multiline procurement. However, inasmuch as roughly 4 years will have passed from the time of the Service's first action to buy Phase II single-line OCRs until the first scheduled delivery, we agree that a significant delay would occur if the Service switched to multiline OCRs.

Estimated savings forgone

A delay would cause the Service to forgo savings it would otherwise accrue if automation were continued undelayed.

We estimated the amount of savings that would be forgone if a delay took place. Because savings are sensitive to ZIP + 4 usage, we computed several estimates, each based on a different ZIP + 4 usage rate. To develop our estimates, we essentially used, without detailed verification, the Service's cash flow projections for the Phase II single-line OCR procurement.¹¹ Our estimates are shown in the following table.

<u>ZIP + 4 usage rate^b</u> (percent)	<u>Phase II</u> <u>Net Savings Forgone^a</u>	
	<u>3-year</u> <u>delay</u> ----- (millions)	<u>4-year</u> <u>delay</u> -----
90	\$802	\$1,050
76	\$682	\$ 894
57	\$508	\$ 666

^aNet savings account for both the costs and the savings that could occur during each year automation was delayed.

^bThe Service had not prepared cash flow projections for other than 90, 76, and 57 percent usage levels.

¹¹We developed our estimates by assuming 3- and 4-year slippages in the Service's cost and savings projections, applying an annual inflation factor (7.42 percent) to certain items, and discounting the results (at a rate of 11.37 percent) to 1984 dollars. (The Service used an annual inflation factor of 7.42 percent to develop its cash flow projections, which we followed. The 11.37 percent discount rate was based on the average yield on outstanding marketable Treasury obligations with remaining maturities during the 1985-98 period, the period covered by the Service's cash flow projections.)

Savings in addition to those above would be forgone, if Phase II were delayed, because of the domino effect on Phase IIA, an addendum to Phase II. Phase IIA involves two equipment buying alternatives--additional OCRs or non-OCR equipment.¹² The Service will decide in 1985 which alternative to use, although it believes use of the non-OCR alternative is the more likely of the two. Using a Postal Service cash flow projection for a Phase IIA procurement, we roughly estimated the additional savings amounts that would be forgone if the non-OCR alternative were selected for Phase IIA. The amounts--in 1984 dollars--ranged

--from \$90 million (assuming a 3-year delay at 57 percent ZIP + 4 usage)

--to \$202 million (assuming a 4-year delay at 90 percent ZIP + 4 usage).

Recovering savings forgone

The Service's ability to recover savings forgone would depend significantly on ZIP + 4 usage. The amount of savings multiline OCRs could produce over single-line OCRs would be directly affected by ZIP + 4 usage. The higher the ZIP + 4 usage level, the greater the difficulty in recovering all forgone savings. (The effect of usage on savings is illustrated in the table on p. 7.) With regard to usage, Service officials believed an automation delay would hinder ZIP + 4 growth by making business mailers unsure about converting to ZIP + 4. On the basis of our earlier ZIP + 4 work,¹³ we believe the Service officials' assumption has merit.

¹²The non-OCR alternative would involve the use of less expensive facer-canceler machines instead of OCRs. Facer-cancelers cancel postage stamps on letter-size mail pieces. While a portion of First-Class Mail was being cancelled, new and upgraded facer-cancelers would identify and separate OCR readable mail from non-OCR readable mail. Using these machines would provide OCRs with more readable mail than they are able to receive now and thereby lessen the amount of mail rejected from the automated system.

¹³Eighteen percent of the 315 large-volume mailers who responded to a 1982 GAO questionnaire said they would wait to convert to ZIP + 4 until after the program had begun and others had converted. This suggests that some businesses would not convert until they were certain of the program's direction and the reaction of other mailers. See p. 106 of Conversion To Automated Mail Processing Should Continue; Nine-Digit ZIP Code Should Be Adopted If Conditions Are Met (GAO/GGD-83-84, Jan. 6, 1983).

STATUS OF MAILER RESPONSE
TO ZIP + 4

Central to the issue of which OCR system the Service should install is whether businesses will address their mail with ZIP + 4 codes. The cost-effectiveness of both machines is enhanced when letters are addressed with ZIP + 4 codes. However, because the single-line machine lacks the ability to "look up" codes, use of ZIP + 4 by mailers is more critical to maximizing the cost-effectiveness of the single-line OCR than the multiline OCR. As of May 1984, businesses had been very slow to adopt ZIP + 4. The Service has taken steps to promote greater usage.

In January, 1984, the Service projected that the following percentages of First-Class, machinable, business mail would be ZIP + 4 addressed:

--27 percent by the end of fiscal year 1984, the first year of the ZIP + 4 program. (The Service projected, as a short-term goal, that 20 percent, or about 11 billion pieces,¹⁴ would qualify for a ZIP + 4 postage discount by the end of the fiscal year. It anticipated that the remaining 7 percent would not qualify for a discount.)

--90 percent by the beginning of fiscal year 1989, the year by which the Service expected the automated system to be fully operational.

The Service is depending heavily on postage rate incentives to bring ZIP + 4 usage to projected levels. Businesses pay less than full postage for First-Class letters addressed with ZIP + 4 codes and mailed in large quantities.

Projected conversions to ZIP + 4
by December 31, 1984

The Service is keeping records of ZIP + 4 "sales" to large businesses. As of late May 1984, 42 of these businesses had added the new code to addresses used for First-Class Mail that is eligible for the ZIP + 4 discount. Another 258 businesses had said they would do so before January 1985. According to the Service, these 300 businesses will generate annually an

¹⁴The Postal Service based this projection on a 1982 study which, as we pointed out in an earlier report, Conversion To Automated Mail Processing And Nine-Digit ZIP Code--A Status Report (GAO/GGD-83-84, Sept. 28, 1983), we could not endorse as being statistically sound.

estimated 2.5 billion pieces of ZIP + 4 mail which will be eligible for the ZIP + 4 discount.¹⁵

If all 2.5 billion mail pieces entered the mail stream in fiscal year 1984, the Service would achieve, by fiscal year's end, only about 23 percent of its fiscal year-end goal of 11 billion pieces of postage-discounted mail.

Current mailer attitudes
about ZIP + 4

To obtain an update on mailer attitudes about ZIP + 4, we obtained information from six business associations which are members of the Service's Mailers Technical Advisory Committee. Members of these associations are, generally, large-volume mailers of First-Class Mail.

The information these associations provided is not intended to be, and should not be construed as, a scientifically valid cross section of ZIP + 4 views. However, from our interviews, we gained the sense that there was interest among businesses in ZIP + 4 but that support for the program was not unanimous. Some businesses were still concerned about the cost of adding the new code to their address files and about whether the ZIP + 4 postage discounts were sufficient to offset these costs. Some were waiting to learn more about the ZIP + 4 program before deciding what to do, and some were wondering whether the Service will eventually end its ZIP Code presort discount program¹⁶ in favor of the ZIP + 4 program.

¹⁵Altogether, the Service's list included 317 businesses. However, the ZIP + 4 addressed mail from 17 businesses which had added the new code to their address files was not eligible to receive the ZIP + 4 postage discount. (Nonetheless, this mail, because it is ZIP + 4 addressed, will help the Service reduce its mail processing costs.) Further, a Service official cautioned that the list of 317 businesses was probably incomplete because local Customer Service Representatives, who contact postal customers, may not yet have reported recent ZIP + 4 sales or, if they had reported them, the reports may not yet have reached postal headquarters. However, the list was the best information readily available on ZIP + 4 sales nationwide.

¹⁶Mailers receive postage discounts for presorting their First-Class Mail for the Service. The Service is counting on mailers who participate in the ZIP Code presort program to also adopt ZIP + 4. Presort mailers who do adopt ZIP + 4 receive, for qualified mail pieces, both the ZIP + 4 discount (0.5 cent) and the presort discount (3.0 cents).

Future ZIP + 4 usage still uncertain

The foregoing discussion should be viewed only as the status of the ZIP + 4 program about two-thirds of the way into its first year of implementation. It should not be used to infer that the program will not ultimately succeed. We lack a basis for assessing the probability that the Service will, or will not, achieve its projected 90 percent usage level by 1989. At this time, mailer usage is still a question mark.

However, the rate incentives¹⁷ approved in October 1983 may become more attractive because a rate proposal being considered by the Postal Rate Commission at the time of our review provided for no increase in the presort discount of 3 cents per piece. Without an increase in the presort discount, major mailers could turn to the ZIP + 4 discount as a way to reduce mailing costs after the next rate increase, which is expected to occur in early 1985.

Service's efforts to increase ZIP + 4 usage

Before February 1, 1984, the Service did not allow presort mailers to commingle ZIP + 4 letters and five-digit ZIP Coded letters in the same presort mailing. Presort mailers generally believed they would be unable to convert 100 percent of their mailing addresses to ZIP + 4 and that, therefore, some letters in every presort mailing would be addressed only with five-digit codes. They were concerned about the potential costs of extracting these ineligible pieces. Not only would they incur the actual cost of culling out the five-digit letters but they would also lose the 3 cent presort discount for each culled letter if there were too few such letters to meet the 500 piece volume requirement for the discount. Likewise, culling out non-ZIP + 4 letters would affect the eligibility of the remaining letters to each receive the 3-cent discount if too few remained to meet volume requirements. Because of the potential cost involved, the Service's "no-commingling" rule discouraged ZIP + 4 conversion by some presort mailers, whose participation is vital to the ZIP + 4 program.

Effective February 1, 1984, the Service eased the problem by temporarily allowing mailers to combine, on a limited basis, ZIP + 4 and five-digit ZIP Coded mail in the same presort mailing. This regulation, to be effective for a 20-month period

¹⁷A 0.5 cent rate incentive is available to mailers using ZIP + 4 on First-Class presorted mail in quantities of not less than 500 pieces. Nonpresorted First-Class Mail bearing the ZIP + 4 code and mailed in quantities of 250 or more pieces receives a discount of 0.9 cent per piece.

(through September 30, 1985), was designed to give presort mailers time to completely convert their mailing lists to ZIP + 4 without forfeiting their presort discount savings during the conversion process.

In another move to increase ZIP + 4 usage, local customer service managers and representatives are being reinstructed to place their major promotion effort on conversion to ZIP + 4. According to the Service, some customer service offices had apparently been focusing almost exclusively on upgrading the OCR readability of 5-digit ZIP Coded mail instead of on ZIP + 4. The Service has let it be known that its objective is conversion to ZIP + 4 and that part of that conversion is address improvement. Also, as part of a broad campaign to encourage ZIP + 4 use, the Service has published a list of some 80 private companies offering some type of service to help businesses convert their address files to ZIP + 4.

POSTAL SERVICE PLANS TO DEVELOP
SINGLE-LINE-TO-MULTILINE OCR
CONVERSION CAPABILITY

During our development of the cost and performance data for the two types of OCRs, we inquired about the feasibility of the Service's continuing its scheduled procurement of single-line OCRs while simultaneously developing, among OCR manufacturers, the capability to convert delivered single-line OCRs to multiline OCRs should desired ZIP + 4 usage not materialize. Because of time constraints, we were unable to explore this option in depth. However, we believe it should be mentioned at least in concept.

OCR manufacturers competing in Phase II said it would be technically feasible to convert single-line OCRs to multiline. They said it would take 10 to 18 months to develop a conversion capability; that is, to develop a retrofit kit ready for testing by the Service. Three of these manufacturers (an estimate was not available from the fourth) gave us estimated costs of mass producing a retrofit kit (including a local ZIP + 4 directory) ranging from about \$100,000 to about \$200,000.

There is, however, a critical element of uncertainty about this option. The performance level that could be achieved is unknown and can be determined only by designing and building a retrofit kit, installing it on a single-line OCR, and testing the converted machine.

In congressional testimony on June 14, 1984, a senior Service official said the Service plans to initiate a strategy to ensure that it has the capability to convert single-line OCRs to multiline readers. To do this, he said, the Service will issue development contracts to the Phase I and II OCR manufacturers

shortly after the award of the Phase II contract for single-line OCRs.

AGENCY COMMENTS

In commenting on a draft of this report, the Postal Service questioned our estimate of a \$45,000 difference between investment costs of the single-line and multiline OCRs. The Service said it believed the difference would be closer to \$200,000. (See p. 22.) We believe the difference between the Service's and our estimates is caused by differences in the data we used to compute multiline OCR costs. The Service computed its cost estimate on the basis of discussions with single-line OCR manufacturers, in-house engineering estimates, and Phase II OCR investment data. We computed our cost estimate on the basis of purchase price data from REI (the sole manufacturer of multiline OCRs designed for processing U.S. mail), the Service's own Phase II OCR investment data, and data from our computer simulations of mail processing. We believe the data sources we used were the best available.

The Service acknowledged the difficulty in comparing the costs of two machines that have not yet been mass produced and actually marketed. We believe the actual cost of a multiline OCR can be determined only through the competitive bidding process.

Regarding ZIP + 4 usage, the Service acknowledged that there had been a wait-and-see attitude on the part of mailers. However, it said the ZIP + 4 postage discounts it was offering and the marketing initiatives it was pursuing were taking effect. The Service said it remained confident that ZIP + 4 usage would steadily grow. (See p. 22.)

CONTRACTOR COMMENTS

With the exception of minor areas which REI suggested we clarify, the company believed the portions of our draft report on which we solicited comments were accurate and represented a good comparison of the two types of OCRs. The points which REI believed needed clarifying (see p. 23) were expanded upon in preceding sections of the final report.



THE POSTMASTER GENERAL
Washington, DC 20260-0010

June 27, 1984

Dear Mr. Anderson:

Thank you for inviting our comments on your draft report entitled, Comparative Review of Single-line Read and Multiline Read Optical Character Readers Used in Mail Processing (Code 220900).

The report's summary of our reasons for selecting the single-line optical character reader (OCR) is correct.

Your estimate of a \$45,000 difference between the single-line OCR and the more costly multiline seems low. We believe the difference will be more like \$200,000. However, as the report recognizes, it is difficult to compare the cost of two machines that have not yet been put into mass production and actually marketed.

As for ZIP + 4 usage, we remain confident it will steadily grow. There has been a wait-and-see attitude on the part of some mailers, but the price discounts we can now offer and the marketing initiatives we are pursuing are taking effect. Another 258 firms, accounting for 2.1 billion pieces of discount eligible First Class mail per year, have committed themselves to using ZIP + 4 codes this year.

Your analysis of the factors to be considered in choosing between the single-line and multiline read OCR's reinforces our belief that we made the right choice.

Sincerely,


William F. Bolger

Mr. William J. Anderson
Director, General Government Division
U.S. General Accounting Office
Washington, D. C. 20548-0001



RECOGNITION EQUIPMENT INCORPORATED
 POST OFFICE BOX 222307
 DALLAS, TEXAS 75222
 TELEPHONE 214/579-6000
 TELEX: 73-0863

CARPENTER FREEWAY
 AT GRAUWYLER ROAD
 IRVING, TEXAS

Recognition

June 6, 1984

Mr. William J. Anderson
 Director
 United States General Accounting Office
 Washington, D.C. 20548

Dear Mr. Anderson:

Thank you for the copy of sections of your draft report relevant to Recognition Equipment Incorporated and the opportunity to provide our comments.

With the exception of a few minor areas of clarification, we at Recognition believe these sections are accurate and represent a good comparison of single-line and multiline optical character readers. Our specific comments on the report are as follows:

1. Page 3-- Based on elapsed time for the Phase I OCR release/loan solicitation, contracting, tests, Phase I RFP, and ultimate contracts (approximately 2 1/2 years), it is not clear why purchase of multiline machines for Phase II automation would require a 45 month delay.
2. Pages 4 and 9-- The GAO estimated that 444 multilines OCR's would be needed to replace the 403 single-line OCR's planned for Phase II. We at Recognition believe that it is not clearly stated in the report why the increased quantity is required and the apparent improvement in productivity achieved with multiline OCR's processing mail both originating at and coming into a post office.
3. Page 5-- Although it is true that the five REI multiline OCR's contain only local directories and that a complete nation-wide directory for each multiline OCR is impractical, the directory memory in our multiline OCR's could be significantly increased to contain key addresses, such as high volume reply mail recipients, located in destinating post offices. This capability could significantly increase ZIP+4 bar coded mail at the originating post offices.

Your consideration to the above comments is appreciated.

Yours sincerely,

Frank Bray
 Manager
 Postal Programs

FB/leb

GAO note: Page references have been changed to correspond with pagination in the final report.

(220900)

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