

Summary

Summary of Technical Analysis

Alternatives to optical character recognition technology. As a starting point, OTA examined possible alternatives to optical character recognition for postal automation technology. Optical character recognition technology reads printed alphanumeric characters (letters and numbers) and recodes these characters into machine-readable forms such as a bar code.

OTA identified several electronic, magnetic, and mechanical alternatives to optical character recognition. However, OTA concluded that, at least for the U.S. mail, it is as yet difficult to improve on the information-carrying ability, readability, and cost effectiveness of printed characters on paper. As long as this is the case, then optical character recognition technology is the technology of choice.

Electronic mail is likely to be the strongest competitor of postal automation. But there most likely will be a significant residual volume of paper mail at least through the year 2000. Thus there is a window of opportunity for further USPS use of paper-based automation technology.

Alternatives to a 9-digit ZIP code. OTA found that there are alternative codes. However, OTA concluded that at this juncture there is no realistic alternative. The 5-digit ZIP is almost universally accepted and used (98 percent usage); the 9-digit ZIP directory is now completed; and ZIP+4 codes are being distributed to large business mailers.

If ZIP+4 becomes widely used, USPS could consider adding a tenth digit (for error checking purposes) at some future time. (Note: The USPS bar code already includes a correction character.) Only if ZIP+4 does not become widely used could alternative codes realistically be considered.

Performance of single-line optical character readers (OCRs). OTA reviewed available data on performance of the single-line OCRs now being installed by USPS. Single-line OCRs read only the last line of an address -- usually containing the city, State, and 5- or 9-digit ZIP code. OTA concluded that, despite initial start-up problems, the already installed OCRs now essentially meet USPS performance specifications.

Performance of multi-line OCRs. Over the last few years, multi-line OCR technology has emerged from the laboratory and prototype stage to operational units. Multi-line machines read up to four lines of the address.

OTA concluded that, as of May 1984, the preponderance of evidence indicates that multi-line OCR performance is essentially equivalent to single-line for reading 9-digit ZIP mail, and that multi-line performance is substantially better for reading 5-digit ZIP

mail to the 9-digit level. * OTA identified one U.S. firm (Recognition Equipment, Inc.) and two foreign firms (Telefunken of Germany, ELSAG of Italy) that have proven multi-line OCRs.

OTA also concluded that USPS has probably underestimated the ultimate operational performance level of multi-line OCRs by 5 to 15 percent. USPS estimated that multi-line OCRs would process 60 percent of 5-digit mail to the 9-digit level. OTA believes that 65 percent is more likely and 75 percent possible.

Feasibility of local and national directories. In order to read, code, and sort S-digit ZIP mail to the 9-digit level, multi-line OCRs require a computerized address directory against which the address information can be compared to ascertain the correct 9-digit ZIP code. They then apply the corresponding barcode, and finally sort the letter.

Until recently, the absence of a local or national directory was a limiting factor for use of multi-line OCRs. However, in the 1981-83 period, USPS completed a national ZIP+4 directory and local ZIP+4 directories for major metropolitan areas. USPS and OTA agree that the conversion of existing local ZIP+4 directories to a multi-line OCR format is technically feasible.

Whereas local directories clearly would be necessary for multi-line OCR operation, OTA was not able to determine whether national directories would offer any significant advantage, particularly when compared to the technical difficulties and likely additional cost.

Feasibility of single-line to multi-line conversion. OTA reviewed the technical feasibility and cost of converting single-line OCRs to multi-line. OTA concluded that conversion would be technically feasible and the USPS estimate of conversion cost -- \$200,000 per machine -- is as good as can be developed from available information.

The actual cost of single- to multi-line OCR upgrade can only be determined by detailed engineering analysis and competitive procurement process. It impossible that the conversion could be accomplished by an OCR manufacturer other than the original source, although this might require a high degree of technical cooperation between the two vendors.

Technical opportunities for improved performance. OTA identified several areas where technical performance of postal automation might be improved in the future. These include bar-coded reply envelopes, mailer printing of bar codes, improvements in performance of optical character readers, standards for address format, and increased research and development on postal automation.

* The full address with 5-digit ZIP is read and compared against a computerized address directory that includes 9-digit ZIP codes. If a match is made between the address on the envelope and an address in the directory, the appropriate 9-digit code is applied.

The USPS record on postal automation R&D is mixed. USPS continues to underspend on R&D compared to the U.S. industry average, and postal R&D organization and management appear to have lacked stability, clear direction and, at times, top level commitment. Despite 20 years of USPS investment in optical character recognition R&D, when USPS solicited manufacturers in 1980 for single-line OCRs, all U.S. manufacturers previously receiving USPS support for single-line OCR R&D had withdrawn from the market, in part due to several years of USPS indecision on an automation strategy.

On the other hand, USPS has established a good track record in narrowly focused R&D on improvements to upgrade existing equipment, such as the multi-position letter sorting machine. Also, despite some variability in funding and commitment, USPS has provided enough support over the last 14 years to Recognition Equipment, Inc. (REI) such that REI has developed one of the leading multi-line OCRs on the world market.

Summary of Decision Analysis

USPS faces a decision point as to whether to continue its commitment to ZIP+4 and single-line OCR technology or to modify that commitment in some way.

OTA employed decision analysis techniques to: identify the range of options available to USPS; develop a probabilistic cash flow model of each option; assign probability distributions for key variables such as ZIP+4 usage and multi-line OCR performance; and calculate the rate of return (ROI), net present value (NPV), total net cash flow, and annual net cash flow for each option; and conduct sensitivity tests of the results to changes in key variables.

Description of decision options.

- o Option A: Phase II single-line OCR is the current USPS strategy to proceed to procurement of the 403 additional single-line OCRs advertised for Phase II of the postal automation program, and on which bids have already been received. Under option A, there would be no further USPS expenditure on multi-line OCR research, development, and testing.
- o Option B: Multi-line OCR with ZIP+4 is a decision to cancel the current Phase II single-line OCR procurement, initiate release-loan testing of multi-line OCRs, and as soon as possible reissue the Phase I request for proposals but for multi-line rather than single-line OCRs, meanwhile retaining the ZIP+4 code. Single-line OCRs already purchased would be converted to multi-line capability.

* OTA did not analyze the option of procuring 403 additional Phase I single-line OCRs instead of Phase II OCRs. This option was judged to be not significantly different from option A.

** The release-loan testing manufacturers actually test prototype equipment on USPS premises with real mail.

- o Option C: Multi-line OCR without ZIP+4 is the same as option B except that the ZIP+4 code would be terminated. The 5-digit ZIP code would be retained.
- o Option D: Automatic conversion is to proceed with the Phase II single-line OCR procurement, but simultaneously initiate release-loan testing (and any necessary related R&D) on single-line to multi-line conversion and then convert all single-line OCRs as soon as possible, regardless of the level of ZIP+4 use.
- o Option E: Hedge conversion is similar to option D except that the single- to multi-line conversion would take place only if ZIP+4 use is low at a specified future time (defined here as year-end 1987). Both options D and E include the same initial decision to purchase Phase II single-line OCRs, and to initiate release-loan testing of and any necessary research on conversion. The difference is that under option D, the conversion would be made regardless of the level of ZIP+4 use, while under option E, conversion would take place only if use is low.
- o Option F: Cancel Phase II and ZIP+4 is to cancel the Phase II single-line OCR procurement, terminate ZIP+4, and use the single-line OCRs already purchased to process 5-digit ZIP mail.
- o Option G: 50-50 Split procurement is a hybrid option that would cancel the Phase II procurement, immediately reissue an RFP for one-half the number of single-line OCRs (202 instead of 403), and simultaneously initiate release-loan testing of the multi-line OCR and single- to multi-line conversion. A new RFP for procurement of the other half of the OCRs but using multi-line technology (201 multi-line OCRs) would be issued as soon as possible, probably in about 2 years, at which time the then existing single-line OCRs (252 from Phase I and 202 from Phase II) would be converted to multi-line.
- o Option H: 90-10 Split Procurement is similar to option G except that the Phase II RFP would be reissued for 90 percent of the single-line OCRs (363), rather than 50 percent, and release-loan testing would be initiated on multi-line OCRs leading to a new RFP for procurement of the other 10 percent of the OCRs (40) using multi-line technology.

Key assumptions. Where possible and justifiable, OTA used the same assumptions as did USPS. For example, OTA and USPS used the same time horizon (14 years, 1985-98), labor cost escalation rate (7.42 percent annually), baseline cost and savings projections (for single-line OCRs, as presented in January 1984 to the Board of Governors), discount rate (15 percent per year), and single-line OCR performance and cost. OTA assumptions about multi-line OCR cost (\$850,000 per machine), single- to multi-line conversion cost (\$200,000 per machine), and the time required to release-loan test and procure multi-line OCRs and conversion kits (3 years) were generally consistent with USPS and GAO estimates.

The major differences between USPS and OTA were assumptions about the incentive rates for ZIP+4 usage (OTA and GAO treated these as a cost, since incentives appear to be required to get large mailers to use ZIP+4), multi-line OCR performance rates (OTA and GAO concluded that performance would likely be somewhat better than USPS estimated), ZIP+4 usage, and clerk/carrier savings rate.

For the latter three variables, OTA developed low, median, and high estimates. For low, median, and high estimates of multi-line OCR performance. OTA concluded that production model multi-line OCRs would read 60, 65, and 75 percent of 5-digit mail to the 9-digit level, respectively.

For ZIP+4 usage, USPS projects that usage would reach 90 percent of the machinable metered first class mail base within 5 years. This is considerably more optimistic than actual experience with either the U.S. 5-digit ZIP code or the Canadian 6-digit postal code. The 5-digit ZIP took 12 years to reach 90 percent usage; after 5 years, the 5-digit usage level was about 51 percent. Thus, the USPS projection shows ZIP+4 reaching 90 percent about two and one-half times as fast as the 5-digit ZIP (in 5 years rather than 12). At present, the projected actual volume of ZIP+4 mail for 1984 is about 20 percent of the original USPS projection.

After reviewing all available evidence, OTA concluded that the USPS ZIP+4 projection should be considered optimistic (high), that an appropriate median estimate would be the 5-digit ZIP growth pattern, and that an appropriate pessimistic (low) estimate would be a growth pattern peaking out at about 40 percent ZIP+4 usage. At the present time, the first year ZIP+4 usage could turn out to be even more pessimistic. The estimated 2.73 billion pieces of ZIP+4 first class mail at year end 1984 represents about 5.4 percent of the target mail base as compared to about 7 percent under the low scenario, 13 percent under the median, and 28 percent under the optimistic scenario. (GAO made no estimate of ZIP+4 usage but did find that businesses are still concerned about the cost of converting and whether the USPS presort discount will be modified because of ZIP+4.)

For clerk/carrier labor savings, OTA concluded that the USPS baseline estimate was probably somewhat optimistic, since the quality and mix of the OCR processed mail may be less than anticipated, and labor costs (e.g., for maintenance) may be more than expected. OTA assumed high, median, and low labor savings rates of 100 percent, 90 percent, and 80 percent of the USPS estimate.

Results of decision analysis. With respect to internal rates of return (ROIs), every option except option F (cancel), under all conditions modeled, shows an ROI above the 15 percent threshold established by USPS. OTA assumed, therefore, that under any scenario, the Phase I single-line OCRs already purchased would be kept in service. All ROIs, net present values, and cash flows were calculated net of cash flows associated with the Phase I single-line OCRs. Use of ROIs for decision making has a serious limitation. When more than one option clears the hurdle rate (that is, has more than the minimum required ROI, in this case 15 percent), the ROI itself gives no indication of the cash flow differences of the various options as a basis for comparing the options. An alternative to ROI frequently used in capital investment decision making is net present value (NPV). NPV discounts the cash flows of each option at the hurdle or threshold rate, in this study 15 percent.

Under conditions of high savings and high multi-line performance, option D (automatic conversion) has about a 5 percent and 11 percent higher NPV with high and median ZIP+ 4 usage, respectively, than option A (single-line OCR). At low ZIP+4 usage, all other things being equal, the option D advantage increases to a substantial 134 percent or about \$820 million in NPV. At a low savings rate (along with low ZIP+4 usage and high multi-line performance), the relative advantage of option D over A increases further to about 310 percent although the absolute advantage decreases to about \$650 million in NPV. Even at low multi-line performance, option D has 53 to 119 percent relative advantage in NPV and a \$320 to \$250 million absolute advantage in NPV, at a high and low savings rate, respectively. Option E (hedge conversion) has the same NPV as option A at high or median ZIP+4 usage and the same NPV as option D at low ZIP+4 usage.

Option H (90-10 split procurement) also has a higher NPV than option A under almost all conditions. Option G (50-50 split procurement) has a significant although somewhat smaller advantage over option A at low ZIP+4 usage. Option G has a 34 to 271 percent relative advantage in NPV and a \$170 to \$710 million absolute advantage in NPV at low ZIP+4 usage, depending on the multi-line OCR performance rate and savings rate.

The ranking of the options by NPV is summarized below:

<u>Overall</u>	<u>NPV Rank</u>	<u>Low ZIP+4 Use</u>	<u>NPV Rank</u>
Option D	1 highest	Option D	1 highest
H	2	E	2 (tie)
E	3	H	3
G	4	C	4
A	5	G	5
B	6	B	6
C	7 lowest	A	7 lowest

OTA found that the NPV results are not very sensitive to the purchase price of the multi-line OCR or the number of multi-line OCR units. An increase in the purchase price from \$850,000 to \$970,000 or an increase in the number of units from 403 to 444 (as estimated by GAO to be required if the entire Phase [1 procurement was switched from single- to multi-line OCRs) would reduce NPV by about \$20 to \$30 million.

Net present value appears to be the best basis for comparative quantitative evaluation of the decision options. However, the actual undiscounted net cash flows over the 13 year payback period (1985-1998) can provide another dimension to the evaluation. Option A (single-line) is estimated to show positive cash flows of \$8.8, \$8.24, and \$3.57 billion at high, medium, and low ZIP+4 usage. At high ZIP+4 usage, option B (multi-line with ZIP+4) is somewhat lower at \$8.14 billion, options D (automatic conversion) and H (90-10 split procurement) somewhat higher at \$9.36 billion and \$9.24 billion respectively, and option G (50-50 split procurement) about the same at \$8.75 billion. The comparisons between options change relatively little at median ZIP+4 usage.

However, at low ZIP+4 usage there is a substantial difference in net cash flows. Option A(single-line) shows a net cash flow of \$3.57 billion. But, depending on the multi-line OCR performance rate, options D (automatic conversion) and H (90-10 split

procurement) show a net cash flow of \$5 to \$7.2 billion, or about \$1.4 to \$3.6 billion greater than option A. Option G (50-50 split procurement) shows about \$1.1 to \$3.3 billion greater cash flow than option A, and option B (multi-line with ZIP+4) shows about \$0.8 to \$3.0 billion greater cash flow than option A.

A comparison of yearly cash flows gives similar results. By 1994, all equipment will presumably have been installed (or converted) and up and running at optimal performance. Options B, D, G, and H will by that time look exactly the same -- all multi-line OCRs. The single-line OCRs procured under options D, G, and H will have been converted to multi-line capability. Option A will continue to be solely single-line OCRs.

With high ZIP+4 usage, option A shows an annual net cash flow of about \$870 million to \$1.2 billion from 1994 to 1998. Options B, D, G, and H show almost identical annual cash flows, only slightly higher by about \$70 to \$100 million per year. However, at low ZIP+4 usage, the differences again become substantial. With high multi-line performance, options B, D, G, and H show between \$440 and \$580 million per year additional net cash flow compared to option A, from 1984 to 1998. With median multi-line performance, the advantage of options B, D, G, and H over A ranges from \$370 to \$490 million per year. And even at low multi-line performance, the advantage over option A, while reduced, is still significant at \$180 to \$240 million per year.