

Decision Analysis

Introduction

USPS is approaching a critical decision point on postal automation strategy. At present, the USPS commitment is to the 9-digit ZIP and single-line OCR. USPS has developed 9-digit ZIP codes (ZIP+4) for the entire United States and prepared a national ZIP+4 directory, although as yet very few mailers are using ZIP+4. Also, USPS has procured and is installing Phase I automation equipment (including 252 single-line OCRs and 248 BSCs) and has received bids on an additional 403 single-line OCRs as part of a Phase II procurement. A selection decision is pending.

However, multi-line OCR technology has advanced to the point where it is fully competitive with single-line OCRs with respect to technical performance in processing ZIP+4 mail. In addition, multi-line technology offers a significant technical performance advantage over single-line OCRs in processing 5-digit ZIP mail to the 9-digit level.

Thus 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.

In order to analyze the USPS decision, OTA has 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; 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.

The options and assumptions used in the decision analysis along with the major results are discussed below. Further details on the modeling methodology and the complete cash flows for each option are included in the appendices.

Decryption of Decision Options

OTA identified eight major decision options. These are listed in figure 4 and described below.

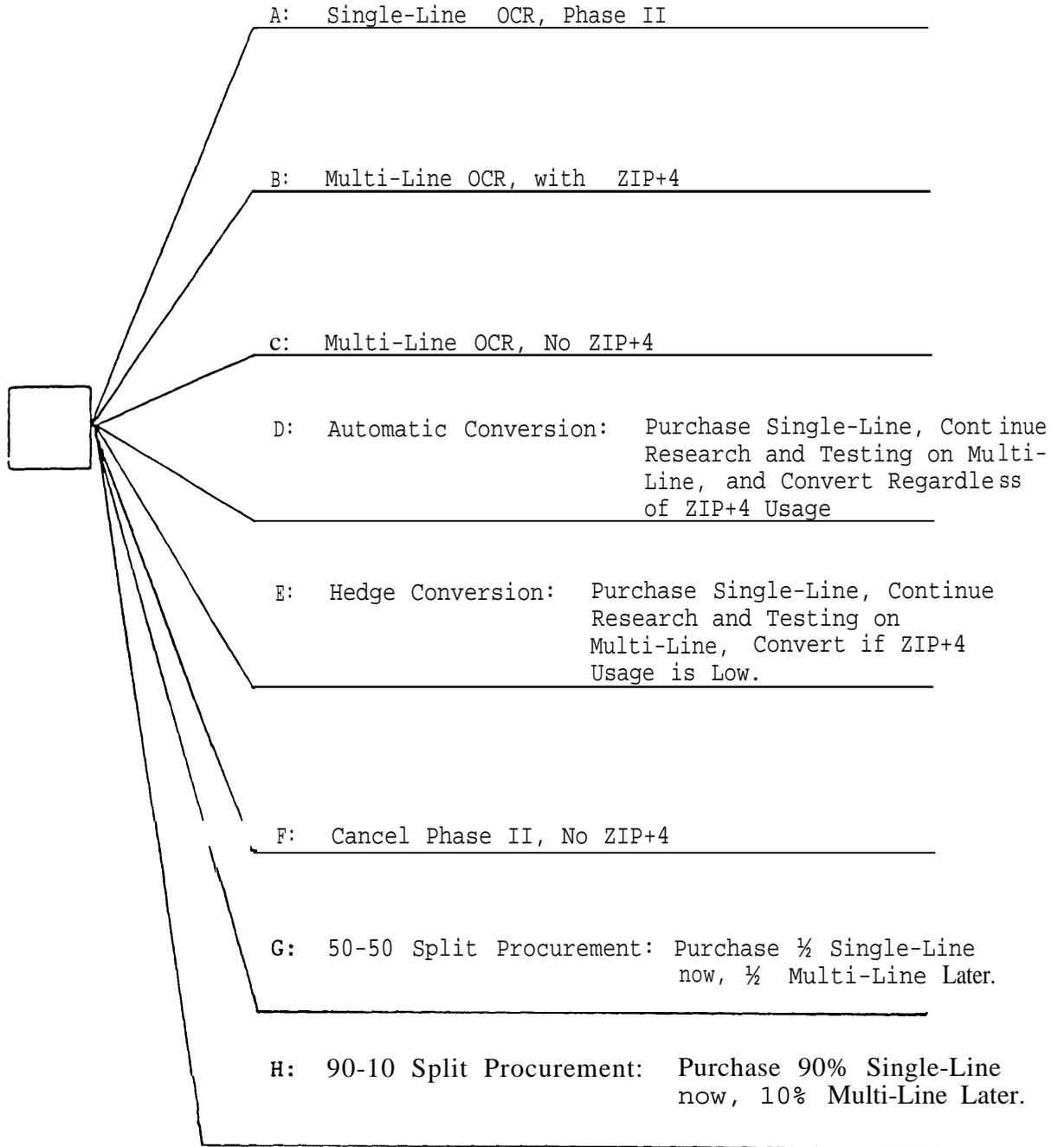
Option A: Phase II Single-Line OCR. Option A is the current USPS strategy to proceed to procurement of the 403 additional single-line OCRs advertised for Phase 11 of the postal automation program, on which bids have already been received. Under option A, there would be no further USPS expenditure on multi-line OCR research, development, and testing.

Option B: Multi-Line OCR with ZIP+4. Option B is a decision to cancel the current Phase 11 single-line OCR procurement, initiate release-loan testing (where manufacturers actually test prototype equipment on USPS premises using real mail) of multi-line OCRs, and as soon as possible reissue the Phase 11 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.

Option C: Multi-Line OCR without ZIP+4. Option C is the same as option B except that the ZIP+4 code would be terminated. The 5 digit ZIP code would be retained.

Option D: Automatic Conversion. Option D 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.

Figure 4
Decision Options



Source: Office of Technology Assessment

Option E: Hedge Conversion. Option E 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.

Option F: Cancel Phase II and ZIP+4. Option F is to cancel the Phase 11 single-line OCR procurement, terminate ZIP+4, and use the single-line OCRs already purchased to process 5 digit ZIP mail.

Option G: 50-50 Split Procurement. Option G is a hybrid option that would cancel the Phase 11 procurement, immediately reissue a Request for Proposals (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 11) would be converted to multi-line.

Option H: 90-10 Split Procurement. Option H 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.

Discussion of Key Assumptions

In developing and modeling the decision options, OTA made a variety of assumptions. The starting point for the OTA analysis was the January 1984 cost, savings, and cash flow projections for single-line OCR procurement (and related equipment including bar code readers and extended ZIP retrofit kits) provided by USPS to the Postal Board of Governors. - Using the USPS data as a base, key assumptions were adopted as is or modified as necessary to fit the decision options analyzed by OTA. These key assumptions are discussed below by option or groups of options.

AllOptions

- o Time horizon. OTA assumed a 14-year time horizon, the same as was used by USPS. Thus, cash flows and ROI/NPV precalculated for the 1985-1998 time period.
- o Labor cost escalation rate. OTA assumed a 7.42 percent annual escalation in clerk/carrier labor costs, as was used by USPS. This escalation rate is based on a 10-year historical average.
- o Baseline cost and savings projections. OTA used the USPS cost and savings projections for single-line OCRs and related equipment. These projections were adjusted for the various options depending on extent and timing of single-line OCR deployment and uncertainties (where applicable) in ZIP+4 use and savings rate.
- o Discount rate. OTA assumed a 15 percent discount rate (or required ROI), as was used by USPS. Compared to the U.S. Government's cost of capital (estimated to be 12.0 to 12.4 percent based on yields on U.S. Treasury bonds maturing in 1998-2001), the USPS discount rate appears to be reasonable.
- o Phase 11A procurement. USPS has identified a possible future procurement of automation equipment as Phase IIA. OTA has excluded this from all options and limited analysis to Phases I and II.

All Options Using ZIP+4 (Options A, B, D, E, G, H)

- o Incentive rates for ZIP+4 use. OTA assumed that the incentive rates offered to volume mailers who use ZIP+4 (0.5 cent for presorted first class and 0.9 cent for nonpresorted first class) is a cost. USPS argues that this is a return to mailers and thus a benefit of ZIP+4, not a cost. However, OTA concluded that the incentive rates are required to get large mailers to convert to ZIP+4, and are therefore appropriately considered a cost. OTA assumed a fixed incentive rate, and that escalating rates would not be necessary to maintain a given level of ZIP+4 usage. Based on these incentives and a detailed mail flow analysis, the General Accounting Office (GAO) estimated an annual cost for incentive rates of \$140 million at 90 percent ZIP+4 usage (GAO, 1983a, p.152). OTA assumed the GAO estimate, with the cost reduced proportionately at lower ZIP+4 usage levels.
- o Savings as a function of ZIP+4 use. OTA assumed for these options that some portions of clerk/carrier savings resulting from automation is a function of the level of ZIP+4 use. For single-line OCRs, OTA used the curve of savings versus ZIP+4 use developed by USPS. For multi-line OCRs, OTA assumed that the USPS curve was pessimistic and developed additional curves (median and optimistic). These curves are presented and discussed in a later section.

All options using multi-line OCRs (Options B, C, D, E,G,H).

- o OTA concluded that USPS assumptions about multi-line OCR performance were pessimistic with respect to the multi-line OCRs ability to read, code, and sort 5-digit ZIP mail to the 9-digit level. OTA developed additional curves, as noted above and discussed later.

All options using single- or multi-line OCRs (options A, B, C, D,E,G, H).

- o OTA concluded that the USPS baseline estimates of clerk/carrier savings were likely to be optimistic, for a variety of reasons discussed later. Therefore, OTA analyzed savings at 100 percent, 90 percent, and 80 percent of the USPS estimates.

Additional assumptions that apply to individual options are presented below.

Option A: Single-line OCR. OTA used the USPS cash flow estimate as the base line, and treated ZIP+4 usage as an uncertainty. During 1985-1988, the deployment period for single-line OCRs, OTA reduced USPS savings estimates by an amount proportional to reduced ZIP+4 usage. For example, if projected clerk/carrier savings in 1986 were based on an USPS-assumed ZIP+4 usage of 57 percent, but estimated by OTA

to be 28 percent, the savings at the lower ZIP+4 level would be calculated at $28/57 = 49$ percent of the USPS estimate. Beyond 1989, when the single-line OCRs would be fully installed and operational, OTA estimated savings by using the USPS curve of clerk/carrier savings versus ZIP+4 use.

Option B: Multi-line OCR with ZIP+4. Here, OTA assumed that for the next three years, 1985-1987, only Phase I single-line OCRs would be in operation, and the Phase I cost and savings estimates apply. The Phase I single-line OCRs would be converted to multi-line at an estimated conversion cost of \$200,000 each, with the cost spread equally over three years, 1988-90, based on best available engineering judgment.

OTA estimates that the cost of Phase II multi-line OCRs would be \$850,000 each (capital and expense), again based on engineering judgment, and compares to the USPS-estimated unit cost (capital and expense) of \$750,120 for Phase II single-line OCRs. OTA assumed that the cost of multi-line OCRs would be spread over three years, 1988-90, which reflects a 3-year delay period (1985-87) for release-loan tests, competitive bidding, and contract award, and that the total number of OCRs would be the same, whether single- or multi-line. OTA assumed an additional multi-line OCR cost of \$5 million per year for 3 years, 1985-87, to cover any further research and development and the release-loan testing of multi-line OCRs prior to procurement. The \$5 million equates to about one-fifth of the 1983 USPS R&D budget. Otherwise, OTA assumed that Phase II equipment costs (bar code sorters, electronic ZIP retrofits, site preparation, address directory information update, and contingency) would be the same as for single-line (Option A).

OTA assumed that savings from the multi-line OCRs would phase in over the 1988-90 period and that full savings would begin in 1991, the year following full

installation. Multi-line savings at a given level of ZIP+4 use are based on the curve of savings versus ZIP+4 use presented later. The curve is treated as an uncertainty, with pessimistic, median, and optimistic performance assumptions built in.

Option C: Multi-line OCR without ZIP+4. Option C is based on the same assumptions as Option B, except that the cost of the ZIP+4 rate incentive is dropped (since ZIP+4 would be terminated) and savings are estimated based on zero use of ZIP+4. For 1985-87, OTA assumed that savings would be the same as for the Phase I single-line OCRs with zero ZIP+4 use. For 1988-90, OTA assumed that one-third of the full savings benefit of Phase I single-line OCR conversion to multi-line would be realized in 1989, and two-thirds of the savings benefit in 1990. OTA assumed that Phase II multi-line OCR savings would phase in over 1988-90, and that full savings of converted Phase I OCRs and Phase II multi-line OCRs would begin in 1991.

Option D: Automatic Conversion. Here, OTA assumed that single-line OCRs would be purchased and installed on the same schedule as in Option A. Over the 1985-87 period, R&D and release-loan testing on single- to multi-line conversion would be conducted at \$5 million per year. All single-line OCRs (Phase I and Phase II) would be converted to multi-line at a total cost of \$31 million (\$200,000 per conversion times 655 units) spread over 3 years, 1988-90. Clerk/carrier savings are assumed to be the same as option A savings through 1990, and the same as option B from 1991 on.

Option E: Hedge Conversion. In option E, OTA assumed conversion of single-line OCRs to multi-line only if ZIP+4 use is low at the end of 1987. If ZIP+4 use is at the high or median level, conversion would not take place and option E would be the same as option A except for a \$5 million per year R&D and release-loan cost for 3 years, 1985-87. If ZIP+4 use is low, then conversion would take place and option E would be the same as option D.

Option F: Cancel. Here, OTA assumed that the Phase 11 OCR procurement would be cancelled, as would the ZIP+4 program and related rate incentives. The 252 single-line OCRs purchased in Phase I would be used to process 5-digit ZIP mail. OTA assumed that maintenance and spare parts costs would be the same, but that there would be no address directory information update cost. Clerk carrier savings for option F were assumed to be the same as with zero percent ZIP+4 use; that is, about 21 percent of the savings achievable at 90 percent ZIP+4 use, per USPS estimates.

OTA used option F as the baseline against which incremental cash flows of other options can be measured.

Option G: 50-50 Split Procurement. For option G, OTA assumed that the 252 Phase I single-line OCRs would be converted to multi-line in 1988-90 (as in options B, C, D); the Phase 11 procurement would be split, with 202 additional single-line OCRs purchased now, installed in 1985-87, and converted to multi-line in 1988-90 (same as option D except at one-half the number of single-line OCR units); and 201 multi-line OCRs would be purchased after release-loan testing and installed in 1988-90 (same as option B except at one-half the number of multi-line OCR units).

Thus, option G is an intermediate option between options B and D and would be expected to roughly split the difference between the two.

Option H: 90-10 Split Procurement. Option H is based on the same assumptions as option G except for the Phase 11 split: 363 (instead of 202) additional single-line OCRs would be purchased now, installed in 1985-87, and converted to multi-line in 1988-90; and 40 (instead of 201) multi-line OCRs would be purchased after release-loan testing and installed in 1988-90.

Discussion of Key Uncertainties

OTA gave explicit consideration to several uncertainties in the decision analysis. These included uncertainty about ZIP+4 usage, multi-line OCR performance, single- and multi-line savings rate, multi-line OCR cost, single- to multi-line conversion cost, multi-line ZIP+4 use, national directory feasibility and cost, single/multi-line OCR obsolescence, and multi-line OCR procurement delay.

The ZIP+4 usage, multi-line performance, and single/multi-line savings rate have proven to be the most controversial uncertainties. These are discussed first, followed by the less controversial uncertainties.

As shown in figure 5, the three most controversial uncertainties were included in many of the decision options. ZIP+4 usage was treated as an uncertainty in analysis of options A, B, D, E, and, by extension, G and H. Multi-line OCR performance was treated as an uncertainty in analysis of options B, C, D, E, G, and H. The single/multi-line savings rate was treated as an uncertainty in options A, B, C, D, E, G, and H.

ZIP+4 Usage. USPS has based its analysis on the assumption that 90 percent ZIP+4 usage will be achieved by the end of 1988. The 90 percent is calculated as a percentage of total machinable, metered first class letter mail of about 51 billion pieces. In order to achieve 90 percent by 1988, USPS assumed the following interim usage rates:

Figure 5

Uncertainties Included in Analysis of Decision options

<u>Decision Option</u>	<u>ZIP+4 Usage</u>	<u>Multi-Line OCR Performance</u>	<u>Single-/Multi- Line Savings Rate</u>
A. Single-Line	Yes	No	Yes
B. Multi-Line with ZIP+4	Yes	Yes	Yes
c. Multi-Line Without ZIP+4	No	Yes	Yes
D. Automatic Conversion	Yes	Yes	Yes
E. Hedge Conversion	Yes	Yes	Yes
F. Cancel	No	No	No
G. 50-50 split Procurement	Yes	Yes	Yes
H. 90-10 split Procurement	Yes	Yes	Yes

Source: Office of Technology Assessment

<u>Year Ending</u>	<u>ZIP+4 Usage Rate</u>	<u>Pieces Of Mail</u>
1984	27 percent	13.8 Billion
1985	48	24.5
1986	66	33.7
1987	85	43.4
1988	90	45.9

As of late May 1984, 59 mailers had actually converted their mailing address files to ZIP+4. Of these, 42 had qualified for ZIP+4 discounts and are expected to generate 401 million pieces on an annual basis. Sixteen of the other 17 are expected to collectively generate 25 million pieces of non-qualifying ZIP+4 first class mail, and the seventeenth, 200 million pieces of third-class mail. Another 258 mailers had given USPS definite commitments to convert to ZIP+4 by December 1984. When fully converted, these 258 mailers are expected to generate a total of 2.1 billion pieces of first class mail annually.

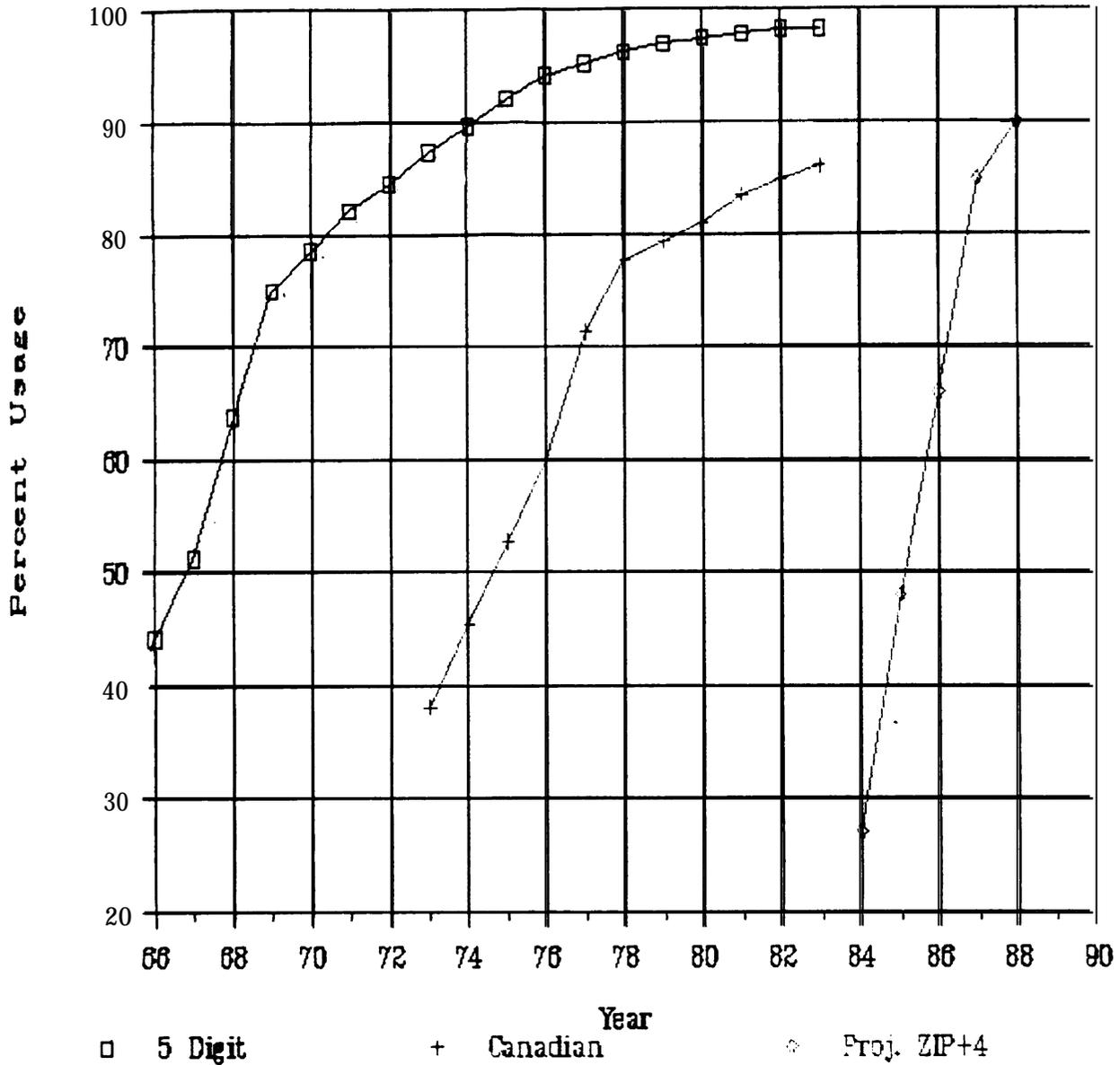
Thus, at present, the projected actual volume of ZIP+4 mail (as a 1984 year-end volume and percentage of total machinable, metered first class mail) is about 2.73 billion pieces or about 19.8 percent of the original USPS projection. It is impossible, of course, that additional mailers will decide to convert before the end of 1984. It is also possible that some of these already committed to convert will not actually do so.

As shown in figure 6, the original USPS projection of 90 percent ZIP+4 usage within 5 years 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 (in 5 years rather than 12).

Figure 6

Comparison of Code Usages

U.S. 5 Digit, Zip+4, and Canadian



SOURCE : United States Postal Service

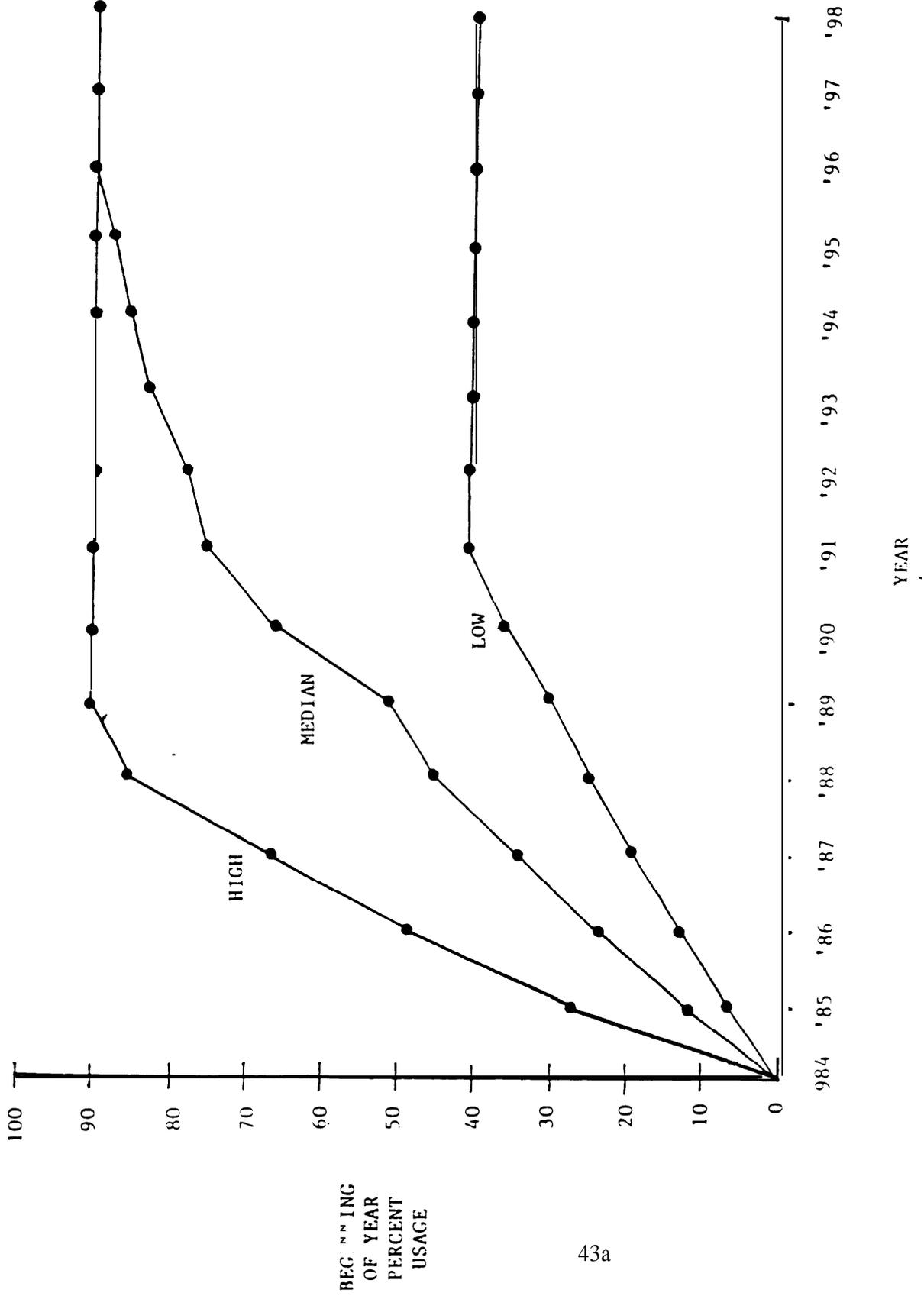
USPS justifies its projection on the grounds that "the technology used by mailers today is dramatically more sophisticated than that of the 1960's, when the 5-digit ZIP code was introduced. The widespread use of the 5-digit ZIP code, the proliferation of office automation and automated mailings, and the ZIP+4 incentive all point to successful and accelerated acceptance of ZIP+4." (USPS, Jellison, 1984c). In 1983, GAO reviewed the one ZIP+4 market study cited by USPS (a 1982 survey conducted for USPS by R.H. Bruskin Associates). GAO expressed reservations about the study methodology (response rate too low, study universe not representative) and was unable to endorse the study results (GAO, 1983b, pp. iv-v, 31-36).

After reviewing all available evidence, OTA concluded that the USPS ZIP+4 projection should be considered optimistic, that inappropriate median estimate would be the 5-digit ZIP growth pattern, and that an appropriate pessimistic estimate would be a growth pattern similar to that of the USPS Electronic Computer Originated Mail Service (E-COM), where actual usage was about one-third of USPS projections. 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 pessimistic scenario, 13 percent under the median, and 28 percent under the optimistic scenario.

OTA's ZIP+4 growth curves are shown in figure 7. OTA assumed that there is a 5 percent chance that actual ZIP+4 usage will equal or exceed the USPS projection (the high growth curve), a 50-50 chance that actual usage will be above or below the median growth curve (that is, it is equally likely that ZIP+4 usage will be above or below the 5-digit ZIP growth curve), and a 5 percent chance that ZIP+4 usage will be equal to or less than the low growth curve. At the present time, ZIP+4 growth is tracking a growth curve lower than the low curve in figure 7.

Figure 7

Growth in ZIP+4 Usage Rate



SOURCE: Office of Technology Assessment and United States Postal Service.

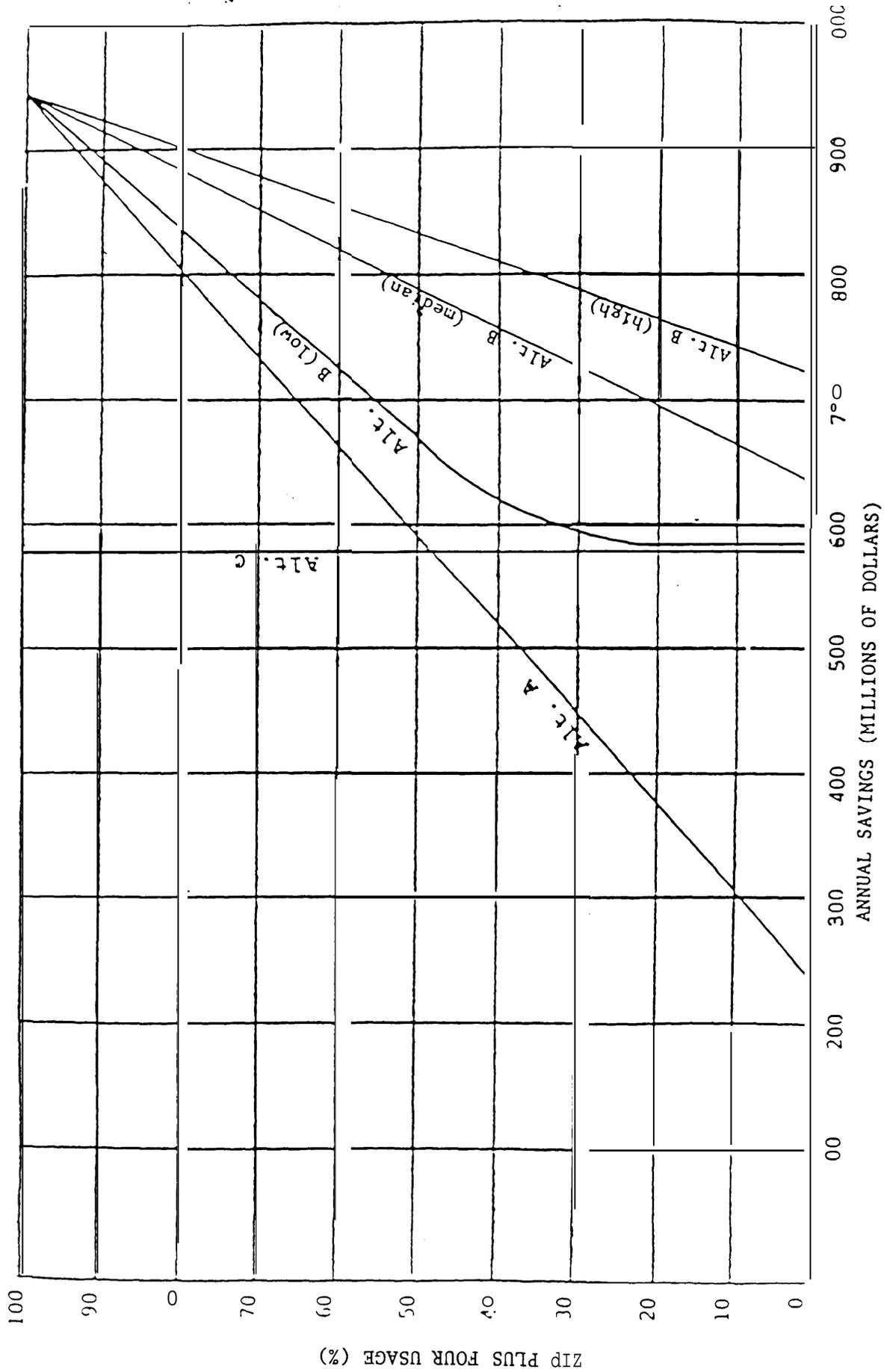
As a final note, GAO recently surveyed six business associations whose members mail large volumes of first class mail. Although not a representative sample, GAO found that while there is some interest in ZIP+4, businesses are still concerned about the cost of converting their address files (even with the current rate incentives) and whether the USPS presort program (and discounts) will end as a result of ZIP+4. In order to promote conversion, USPS is allowing "comingling" or mixing of up to 15 percent non-ZIP+4 mail in a ZIP+4 presort first class mailing until February 1, 1985, and up to 10 percent until October 1, 1985. As yet, however, there is little evidence that business mailers are giving ZIP+4 conversion a high priority.

Multi-line OCR performance. A major advantage of multi-line OCRs is the ability to read, code, and sort 5-digit ZIP mail to the 9-digit level. That is, unlike the single-line OCR, the multi-line OCR can process a significant percentage of 5-digit ZIP mail as if the ZIP+4 were being used but without actually requiring the ZIP+4 code to be on each letter. The multi-line OCR does this by matching the multi-line address information on the envelope with address and ZIP+4 information stored in a computerized address directory. Even though there is no ZIP+4 code on the envelope, when a match is made, the multi-line OCR prints the 9-digit barcode on the envelope.

At issue is not whether but how well the multi-line OCR can process 5-digit mail to the 9-digit level. USPS has estimated that the multi-line OCR can process 60 percent of 5-digit mail accepted by the OCR to the 9-digit level extra based on acceptance tests of the REI equipment. However, USPS notes that the 60 percent is "a projection that was not fully tested." Based on the 60 percent multi-line performance estimate (5-digit to 9-digit level) and more complete data available on single- and multi-line OCR processing of 9-digit (ZIP+4) mail, USPS developed a set of curves shown in figure 8 as alternatives A,

Figure 8

Estimates of 989 Clerk/Carrier Savings



SOURCE: United States Postal Service (curves for Alternatives A, B (low), C); and Office of Technology Assessment (curves for Alternatives B (Median) and B (high)).

Alt. A = Single-Line OCR With ZIP+4
Alt. B = Multi-Line OCR With ZIP+4
Alt. C = Multi-Line OCR Without ZIP+4

B [low], and C. These curves show the estimated annual clerk/carrier savings (in 1989 dollars) as a function of ZIP+4 usage for single-line OCRs and for multi-line OCRs with and without ZIP+4.

As discussed previously in the technical analysis, OTA concluded that the USPS estimate of 60 percent was pessimistic. OTA assumed that there was only a 5 percent chance that actual multi-line performance would be equal to or less than this low estimate. OTA concluded that a reasonable median estimate of performance was 65 percent, with a 50-50 chance that actual performance will be above or below, and that a reasonable high estimate was 75 percent, with a 5 percent chance that actual performance would equal or exceed this level.

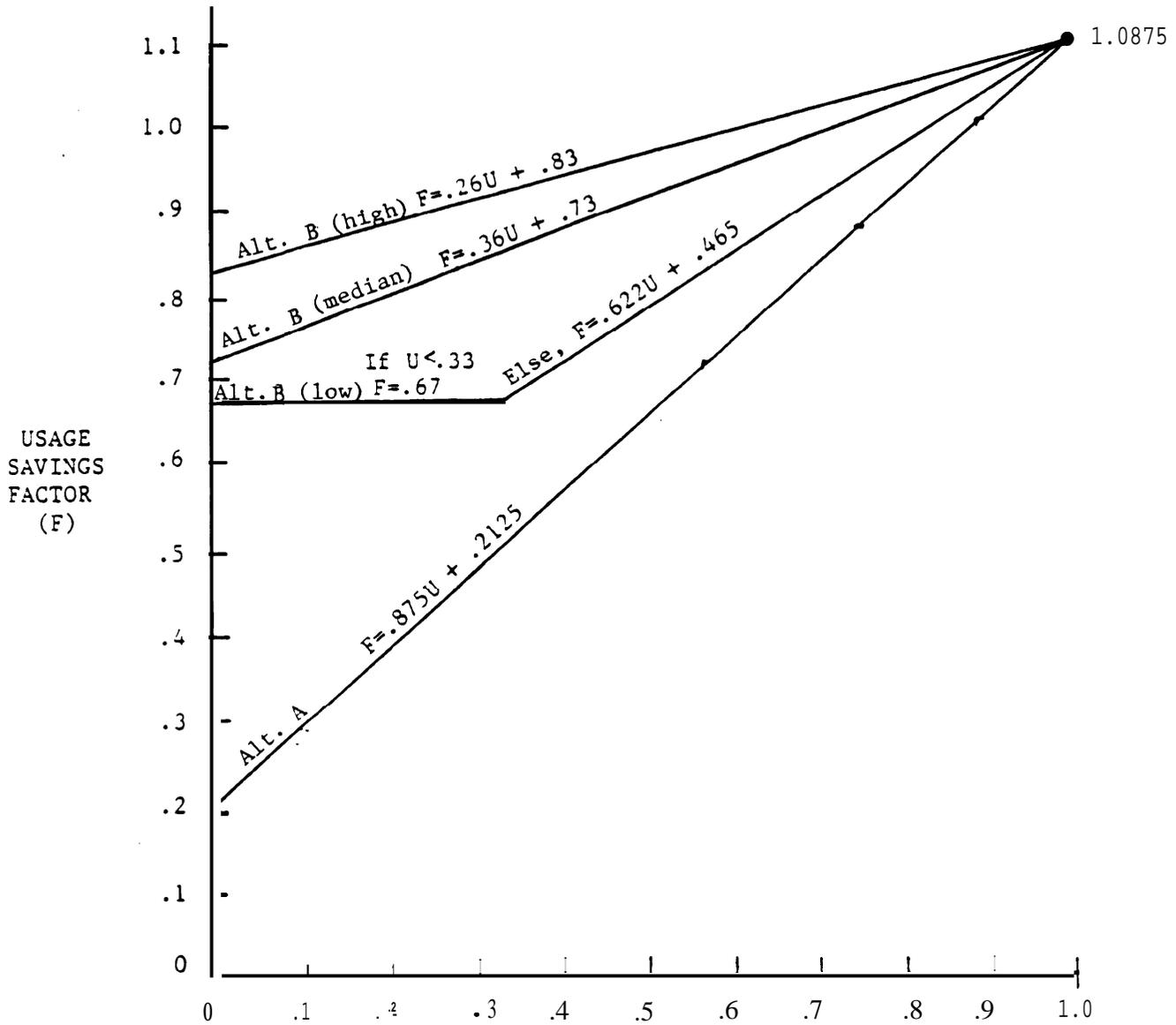
The multi-line OCR savings curves associated with low (60 percent), median (65 percent), and high (75 percent) performance are shown in figure 8. OTA used the USPS multi-line OCR savings curve as the low performance curve (marked as Alt. B (low) in figure 8), and developed new savings curves for median and high multi-line OCR performance (marked as Alt. B [median] and Alt B. [high], respectively, in figure 8). The x-intercepts of the three multi-line curves (savings at 0 percent ZIP+4 usage) correspond to about 67, 73, and 83 percent of the single-line OCR savings at 90 percent ZIP+4 usage. Thus, based on this set of curves, at zero percent ZIP+4 usage the annual savings estimates are approximately \$580 million, \$635 million, and \$720 million for the three multi-line OCR alternatives, as compared to about \$230 million for the single-line OCR alternative. (Note: The savings percentage at 0 percent ZIP+4 for Alt. B [low] was calculated by dividing \$580 million, the multi-line savings at 0 percent ZIP+4 usage, by \$870 million, the single-line savings at 90 percent ZIP+4 usage equals approximately 67 percent. Then, to estimate the multi-line savings percentage at 65 percent and 75

percent performance levels corresponding to Alt. B [median] and Alt. B [high], respectively, simple ratios were calculated: 65 percent/60 percent X 0.67 equals approximately 73 percent for Alt. B [median], and 75 percent/60 percent X 0.67 equals approximately 83 percent for Alt. B [high].)

As is evident from figure 8, the USPS multi-line with ZIP+4 curve (Alt. B. [low]) has an elbow in it, with no increase in the savings level occurring until ZIP+4 usage exceeds about 20 to 25 percent. USPS defends this "elbow" on the grounds that up to about 20 percent ZIP+4 usage, the read redundancy in the address and the ZIP+4 code negates any advantage from the multi-line OCR. [n other words, USPS believes that the higher quality mail will be the first to use ZIP+4, and thus there will be no immediate benefit from multi-line processing. OTA was unable to establish a satisfactory engineering justification for this redundancy effect, and USPS was unable to provide a detailed explanation. Therefore, while OTA included the elbow in the USPS-estimated curve used as multi-line alternative B [low], OTA excluded the elbow for alternatives B [median] and B [high]. For these multi-line alternatives, OTA assumed a linear relationship between ZIP+4 usage and savings.

For modeling purposes, OTA converted the figure 8 curves into a set of normalized linear equations using ZIP+4 usage as the independent variable and usage savings factor as the dependent variable. A usage savings factor of 1.0 equates to 100 percent of the savings projected for the single-line OCR alternative at 90 percent ZIP+4 usage. The set of curves corresponding to the linear equations is shown in figure 9. The slope of the single-line OCR curve was adjusted slightly to be consistent with the ZIP+4 sensitivity analyses included in the 1984 USPS proposal to the Postal Board of Governors (savings factors of 1.0, 0.866, and 0.72 at ZIP+4 usage rates of 0.9, 0.76, and 0.57 [corresponds to 90 percent, 76 percent, and 57 percent ZIP+4 usage]).

Figure 9
Usage Savings Factors



Alt. A = Single-Line OCR
 Alt. B = Multi-Line OCR with
 (low) performance
 (median) performance
 (high) performance

SOURCE: Office of Technology Assessment

Single/multi-line savings rate. In addition to uncertainty over ZIP+4 usage and multi-line OCR performance, OTA included an uncertainty over the baseline level of clerk/carrier savings estimated by USPS. USPS asserts that their estimates are conservative, since the estimates "do not include additional savings from a reduction in operator scheme training, increased employee flexibility, error reduction, or the potential for encoding mail manually." USPS also points out that the savings estimates are based on machinable first-class mail only, and do not include savings from non-machinable first class mail or from semi-automated processing of ZIP+4 coded flats and parcels (for example, by using a wand reader or laser scanner).

On the other hand, the USPS savings estimates are vulnerable to lower than anticipated volume and/or higher than expected costs. Some large mailers may develop techniques for totally bypassing the OCRs, for example, by applying bar codes to outgoing letters at the same time addresses are printed. This would be an extension of presorting letters to the carrier route level, which is apparently already competing with postal automation. [f a significant amount of machinable, easy to read (trayed and clean) first class mail is presorted and bypasses the OCRs, the OCRs would be left with a higher relative volume of lower quality mail with a lower OCR performance level to be expected. The net result could be a considerable decrease in OCR productivity and savings.

This downside potential is dramatized by comparing single-line OCR accept rates (percentage of mail fed to an OCR that is accepted by the machine) for different types of mail. USPS assumed, for example, an accept rate of 90 percent for presort first class mail but only 50 percent for collection box mail and 75 percent for bulk business mail. To the extent the OCR mail mix changes such that presort decreases relative to other

mail types, then the overall OCR accept, productivity, and savings rates would decline, all other things being equal.

As to the possibility of higher than expected costs, the greatest vulnerability appears to be in the labor area, not in equipment. Although it is too early to have hard figures, it is possible that OCR maintenance labor costs will be higher than anticipated.

All factors considered, OTA concluded that the USPS baseline estimate of clerk/carrier savings was probably somewhat optimistic. OTA assumed that there is a 5 percent chance that the actual savings rate will equal or exceed 100 percent of the USPS baseline savings estimate, a 50-50 chance that the savings rate will be above or below 90 percent of the USPS baseline estimate, and a 5 percent chance that the actual rate will be equal to or less than 80 percent of the USPS estimate.

Multi-line OCR Cost. OTA noted some uncertainty about the purchase and maintenance costs of the multi-line OCR. Firm estimates are not possible in the absence of a competitive bidding on and operational experience with a large number of multi-line OCRs. USPS has estimated that multi-line OCRs would cost \$200,000 more per unit to buy than single-line OCRs, or about \$950,000 compared to the \$750,000 (per single-line OCR unit (capital and expense) used in the USPS proposal to the Postal Board of Governors.

However, based on best available engineering judgment, OTA concluded that a \$100,000 purchase cost difference is more realistic. Also, OTA conducted a sensitivity analysis on multi-line OCR purchase prices of \$750,000, \$850,000, and \$950,000 and found that the impact on ROI/NPV was negligible, as will be discussed in a later section.

As for multi-line OCR maintenance cost, OTA concluded that the cost of updating the multi-line OCR address directory would probably be greater than updating the single-line OCR directory. USPS has very roughly estimated this additional maintenance cost at one work year per local directory per year (equivalent to three persons working for 4 months). Since 209 local directory updates would be needed (the number of cities projected to have OCRs), the additional yearly directory maintenance cost is estimated to be about \$9.32 million (209 local directory updates times \$44.6K per average work year). This amount is negligible (on the average one percent or less) compared to the total yearly multi-line savings, and therefore was excluded from further analyses.

Single- to multi-line conversion cost. In the absence of firm estimates, OTA assumed a conversion cost of \$200,000 per unit, based on best available engineering judgment.

Multi-line ZIP+4 usage. USPS believes that use of multi-line OCRs would likely have a detrimental effect on mailer acceptance and use of ZIP+4. In other words, all other things being equal, USPS believes that ZIP+4 usage would be less for a multi-line OCR system than for a single-line OCR system.

While a few mailers have indicated that a USPS switch to multi-line OCRs would reduce the likelihood of converting to ZIP+4, the cost of conversion, level and stability of USPS ZIP+4 rate incentives, and relationship to USPS presort rate incentives appear to be much more important to mailers than the type of OCR equipment used by USPS. In sum, the available evidence suggests that mailers base their decisions about ZIP+4 use primarily on economic and financial factors and not on technological factors.

In addition, even the concerns stated by USPS would appear to be moot for options including an initial purchase of some or all of the Phase II single-line OCRs and subsequent conversion to multi-line capability. Since actual conversion would probably not begin for about 3 years, by that time it should be clear to what extent USPS projections of ZIP+4 usage with a single-line OCR system are being met.

National directory feasibility and cost. OTA originally included the cost of computerized national directories as a charge against multi-line OCR options, on the theory that national directories would be necessary for effective use of multi-line OCRs. However, upon further analysis, OTA concluded that national directories, while technically feasible, were not necessary, since the use of local directories in the origin and destination cities amounts to a de facto national directory. In addition, since a national directory has not yet been developed, estimating costs would be very difficult. As a result of these factors, the cost of national directories was removed from further consideration. (The cost of local directories was, of course, reflected in the estimates of multi-line OCR purchase 'price and single- to multi-line conversion price.)

Single/multi-line OCR obsolescence. OTA originally included as an uncertainty the obsolescence date for Phase II single-line OCR equipment (i. e., a 5 percent chance of becoming obsolete in 1994 or earlier). However, OTA concluded that the single-line OCRs could be upgraded, if necessary, to use new technologies and/or perform new or expanded functions. Therefore, the equipment obsolescence date was excluded as an uncertainty. All equipment was assumed to remain operational through 1998.

Multi-line OCR procurement delay. OTA originally assumed a 2-year delay in OCR procurement if USPS switched from single-to multi-line OCRs. Upon further analysis. OTA concluded that a 3-year delay was more reasonable, based on best available

engineering judgment and USPS experience with single-line OCR release-loan testing, assuming no change in USPS procurement-practices. USPS has likewise estimated a 3-year delay as more realistic, given the need to issue a new solicitation for release-loan testing of multi-line OCRs.

Results of Decision Analysis

Probabilistic cash flow models were developed for each option using the assumptions and uncertainties discussed previously. The models were then used to project estimated yearly cash flows, rate of return, and net present value for each decision option. (See appendices A and B for a detailed presentation of the models and cash flows for all options except options G and H, which were estimated by interpolation.)

The purpose of the modeling is to provide both absolute and comparative financial projections for each decision option. However, while the models generate numbers that appear to be very specific, the user of the results must understand that all projections are subject to some imprecision, especially in view of the large number of assumptions and uncertainties. But as long as these assumptions and uncertainties are treated consistently, the results should provide a valid basis for comparison among options.

Results of the decision analysis are presented below in the following order: rates of return, net present values, supplemental sensitivity analysis, and overall cash flows.

Rates of return. The cash flow models were used to estimate internal rates of return (ROIs) for each option under each condition of uncertainty. The ROIs were estimated on an incremental basis over option F (cancel), since OTA assumed that under

any scenario, the Phase I single-line OCRs already purchased would be kept in service. Thus option F is in effect the baseline option. In essence, all ROIs are net of cash flows associated with Phase I single-line OCRs.

The estimated ROIs for all options under various conditions are shown in figure 10. Every option under all conditions modeled shows an ROI above the 15 percent threshold established by USPS. The lowest ROI is 20.6 percent, for option A (single-line OCR) under low ZIP+4 usage and a low savings rate. Only if ZIP+4 was even lower (e.g., peaked out at 20 percent usage instead of the 40 percent assumed in the low usage scenario) and/or the savings rate was even lower (e.g., 70 percent of USPS estimates instead of the 80 percent assumed in the low savings rate scenario) would the option A ROI drop below 15 percent.

The highest ROI is 84.6 percent, for option D (automatic conversion) under high ZIP+4 usage, multi-line performance rate, and savings rate. However, under these conditions options A (single-line OCR), E (hedge conversion), and H (90-10 split procurement) have only a slightly lower estimated ROI. The greatest difference between option D (automatic conversion) and option A (single-line OCR) occurs with low ZIP+4 usage and high multi-line OCR performance. Under these conditions, the option D ROI is anywhere from 33 to 50 percent higher than the option A ROI.

The relative ROI ranking of the various options as a function of ZIP+4 usage is as follows (excluding option F, cancel, which has a negative ROI):

Figure 10

Estimated Percentage Rates of Return for
Decision Options Under Various Conditions

	Multi-line OCR Performance Rate											
	Low			Median			High					
	Savings Rate			Savings Rate			Savings Rate			Savings Rate		
	L	M	H	L	M	H	L	M	H	L	M	H
High ZIP+4 Usage												
Option A	56.4	69.2	83.5									
Option B				45.6	58.2	74.7	46.4	59.0	75.5	46.7	59.3	75.7
Option D				56.6	69.6	84.2	57.1	70.0	84.5	57.3	70.2	84.6
Option E*	56.4	69.2	83.5									
Option G**				51.1	63.9	79.6	51.8	64.5	80.0	52.0	64.8	80.2
Option H**				55.5	68.5	83.3	56.0	68.9	83.6	56.2	69.1	83.7
Median ZIP+4 Usage												
Option A	37.4	43.6	49.7									
Option B				33.7	39.7	45.7	35.0	41.0	47.0	35.4	41.5	47.5
Option D				37.8	44.1	50.3	38.8	45.1	51.2	39.2	45.4	51.5
Option E*	37.4	43.6	49.7									
Option G**				35.8	41.9	48.0	36.9	43.1	49.1	37.3	43.5	49.5
Option H**				37.4	43.7	49.8	38.4	44.7	50.8	38.8	44.7	51.1
Low ZIP+4 Usage												
Option A	20.6	25.3	29.7									
Option B				22.3	26.7	30.8	27.8	32.1	36.1	29.5	33.8	37.8
Option D				25.3	29.8	34.0	29.7	34.0	38.1	31.1	35.4	39.4
Option E*				25.3	29.8	34.0	29.7	34.0	38.1	31.1	35.4	39.4
Option G**				23.8	28.3	32.4	28.8	33.1	37.1	30.3	34.6	38.6
Option H**				25.0	29.5	33.7	29.5	33.8	37.9	30.9	35.2	39.2
Zero ZIP+4 Usage												
Option C				32.3	37.8	43.2	34.4	39.9	45.3	37.6	43.1	48.5

* ROIs for Option E are the same as Option A at high and median ZIP+4 usage and the same as Option D at low usage.

** ROIs for Options G and H were calculated by interpolation from Options B and D (i.e., Option G was assumed to have an ROI that split the difference between Options B and D).

NOTE: All ROIs are incremental over Option F (cancel)

Source: Office of Technology Assessment

High and Median ZIP+4 Usage

Option D	Highest ROI
Option H	
Options A and E	
Option G	
Option B	Lowest ROI

Low ZIP+4 Usage

Option C	Highest ROI
Options D and E	
Option H	
Option G	
Option B	
Option A	Lowest ROI

Thus, at high or median ZIP+4 usage, options D and H have the highest ROIs. And at low ZIP+4 usage, options C, D, E, and H have the highest ROIs.

Net present values. Use of ROIs for decisionmaking 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 decisionmaking is net present value (NPV). NPV discounts the cash flows of each option at the hurdle or threshold rate, in this study 15 percent.

Estimated NPVs for all options under all conditions (except option F, cancel, which has a negligible NPV of \$232,199) are shown in figure 11. The relative ranking of the options based on NPV is the same as the ranking based on ROI, except for option C. However, there is a significant difference in the absolute rankings when using NPV.

Figure 11

Estimated Net Present Values (in billions of dollars)
for Decision Options Under Various Conditions

	Multi-line OCR Performance Rate											
	Low			Median			High					
	Savings Rate			Savings Rate			Savings Rate			Savings Rate		
	L	M	H	L	M	H	L	M	H	L	M	H
High ZIP+4 Usage												
Option A	1.50	1.91	2.33									
Option B				1.07	1.42	1.77	1.12	1.48	1.84	1.14	1.050	1.86
Option D				1.51	1.93	2.35	1.57	1.99	2.42	1.59	2.01	2.44
Option E*	1.50	1.91	2.33									
Option G**				1.29	1.68	2.06	1.35	1.74	2.13	1.36	1.76	2.15
Option H**				1.47	1.88	2.29	1.53	1.94	2.36	1.55	1.96	2.38
Median ZIP+4 Usage												
Option A	1.05	1.38	1.71									
Option B				0.82	1.12	1.41	0.90	1.21	1.51	0.93	1.24	1.55
Option D				1.09	1.43	1.77	1.17	1.52	1.87	1.19	1.55	1.90
Option E*	1.05	1.38	1.71									
Option G**				0.96	1.28	1.59	1.04	1.37	1.69	1.006	1.40	1.73
Option H**				1.06	1.40	1.73	1.14	1.49	1.83	1.16	1.52	1.87
Low ZIP+4 Usage												
Option A	0.21	0.41	0.61									
Option B				0.30	0.50	0.70	0.59	0.83	1.07	0.70	0.95	1.20
Option D				0.46	0.70	0.93	0.75	1.03	1.30	0.86	1.15	1.43
Option E*				0.46	0.70	0.93	0.75	1.03	1.30	0.86	1.15	1.43
Option G**				0.38	0.60	0.82	0.67	0.93	1.17	0.78	1.05	1.32
Option H**				0.44	0.68	0.91	0.73	1.01	1.28	0.84	1.13	1.41
Zero ZIP+4 Usage												
Option C				0.58	0.78	0.99	0.69	0.91	1.13	0.87	1.11	1.36

* NPVs for Option E are the same as Option A at high and median ZIP+4 use and the same as Option D at low usage.

** NPVs for options G and H were calculated by interpolation from Options B and D (i.e., Option G was assumed to have a NPV that split the difference between Options B and D).

NOTE: All NPVs are incremental over Option F (cancel).

Source: Office of Technology Assessment

Under conditions of high and medium ZIP+4 usage, high savings, and high multi-line performance, option D (automatic conversion) has about a 5 percent and 11 percent higher NPV, respectively, than option A (single-line OCR). At low ZIP+4 usage, 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, with low ZIP+4 usage option D has a 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 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.

The net NPV advantage or disadvantage of options D, G, and H compared to option A is shown in figure 12 for various conditions. Relative as well as absolute comparisons are included for low ZIP+4 usage. The results clearly show that options D and H have a marginally higher NPV at high and medium ZIP+4 usage under all conditions and a substantially higher NPV at low ZIP+4 usage. On the other hand, option G has a marginally lower NPV than option A at high ZIP+4 usage and median ZIP+4 usage with low or median multi-line performance, a marginally higher NPV at median ZIP+4 usage and high ZIP+4 performance, and a substantially higher NPV under all low ZIP+4 conditions.

Another way to present these results is shown in figure 13. Here, the 80 percent credible values are shown for each option along with the overall net present value for

Figure 12

Comparison of Net Present Values (in percentages and billions of dollars)
of Options D, G, and H with Option A

	Multi-line OCR Performance Rate								
	Low			Median			High		
	Savings Rate			Savings Rate			Savings Rate		
	Low	Med.	High	Low	Med.	High	Low	Med.	High
High ZIP+4 Usage									
Option D (\$)	0.01	0.02	0.02	0.07	0.08	0.09	0.09	0.10	0.11
Option G (\$)	-0.21	-0.23	-0.27	-0.15	-0.17	-0.20	-0.13	-0.15	-0.18
Option H (\$)	-0.03	-0.03	-0.04	0.03	0.03	0.03	0.05	0.05	0.05
Median ZIP+4 Usage									
Option D (\$)	0.04	0.05	0.06	0.12	0.14	0.16	0.14	0.17	0.19
Option G (\$)	-0.09	-0.10	-0.12	-0.01	-0.01	-0.01	0.01	0.02	0.03
Option H (\$)	0.01	0.02	0.02	0.09	0.11	0.12	0.11	0.14	0.16
Low ZIP+4 Usage									
Option D (%)	119	71	53	257	151	113	310	181	134
(\$)	0.25	0.29	0.32	0.54	0.62	0.69	0.65	0.74	0.82
Option G (%)	81	46	34	209	127	92	271	156	116
(\$)	0.17	0.19	0.21	0.46	0.52	0.56	0.57	0.64	0.71
Option H (%)	110	66	49	248	146	105	300	176	131
(\$)	0.23	0.27	0.30	0.52	0.60	0.67	0.63	0.72	0.80

Notes: Option D= Automatic conversion.
Option G = 50-50 Split procurement.
Option H = 90-10 Split procurement.
All dollar figures in billions and are net of Option A NPV from Figure 11.
All NPVs are incremental over Option F (cancel).

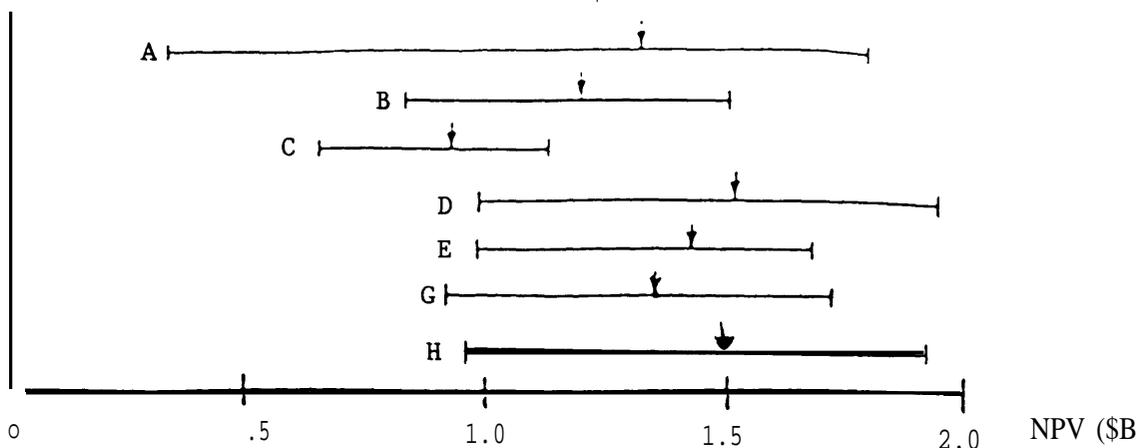
Source: Office of Technology Assessment

Figure 13

80% Credible Intervals on NPV (Overall & Conditional)

Options

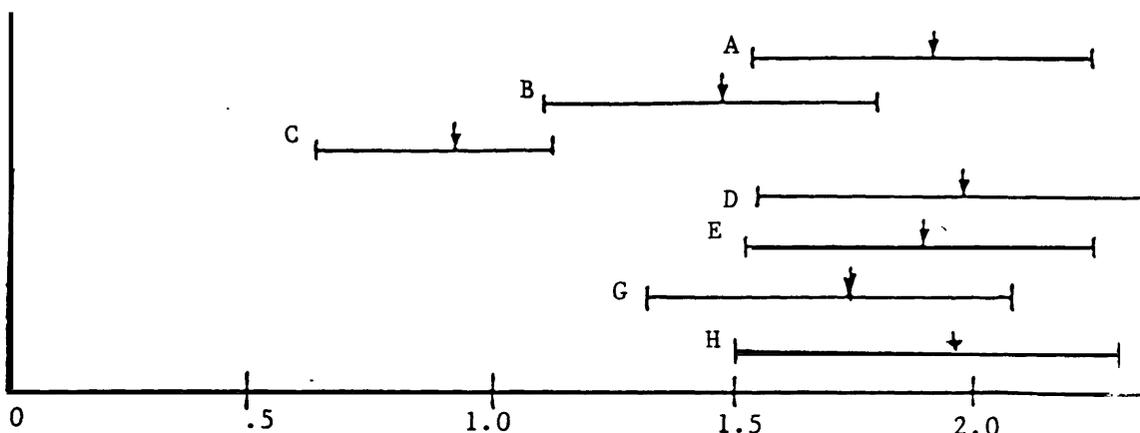
- A. Single
- B. Multi with ZIP+4
- C. Multi no ZIP+4
- D. Convert
- E. Hedge
- G. 50-50 Split Procurement
- H. 90-10 Split Procurement



Conditional

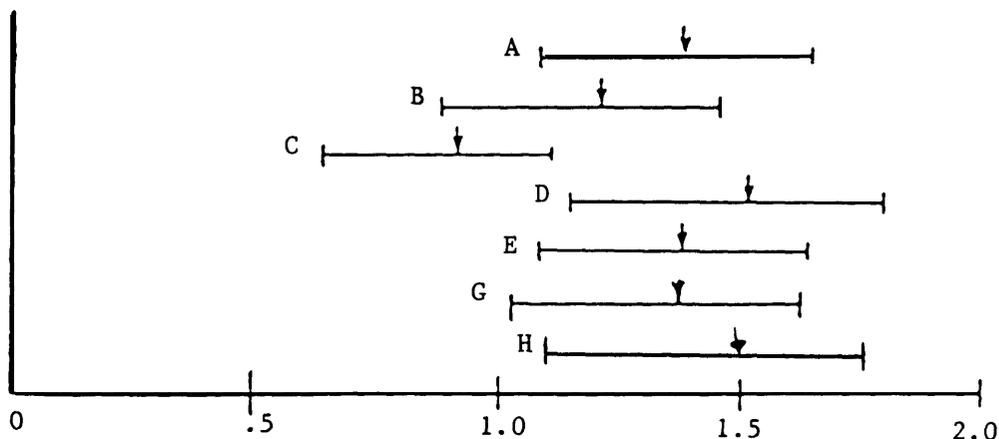
HIGH ZIP+4 USAGE

- A. Single
- B. Multi with ZIP+4
- C. Multi no ZIP+4
- D. Convert
- E. Hedge
- G. 50-50 Split Procurement
- H. 90-10 Split Procurement



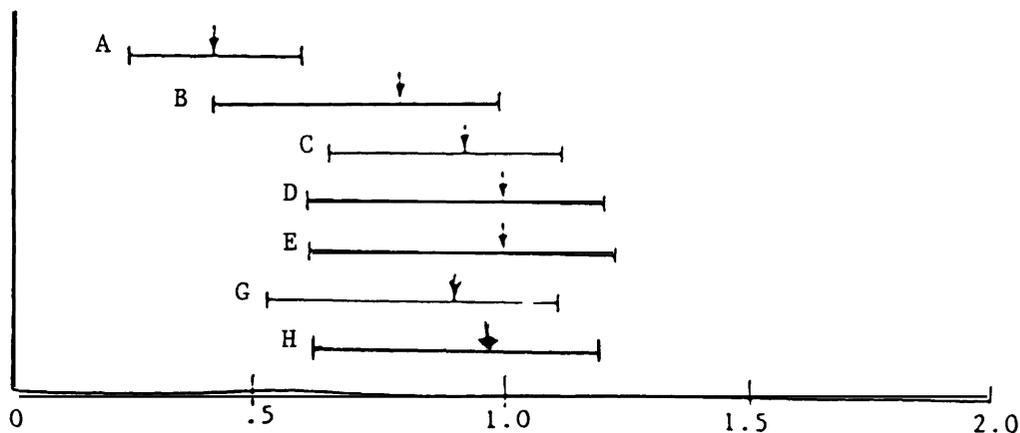
MEDIAN ZIP+4 USAGE

- A. Single
- B. Multi with ZIP+4
- C. Multi no ZIP+4
- D. Convert
- E. Hedge
- G. 50-50 Split Procurement
- H. 90-10 Split Procurement



LOW ZIP+4 USAGE

- A. Single
- B. Multi with ZIP+4
- C. Multi no ZIP+4
- D. Convert
- E. Hedge
- G. 50-50 Split Procurement
- H. 90-10 Split Procurement



each option. The 80 percent credible interval means that there is a 10 percent chance of NPV being above the largest value and a 10 percent chance of NPV being below the smallest value. The NPVs and credible intervals are shown overall and conditional on ZIP+4 usage.

Figure 13 shows, in effect, the ranking of the options by expected net present value and the range of uncertainty in NPV associated with each option, both overall and conditional on ZIP+4 use. The ranking of the options by expected NPV is summarized below:

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

Thus, option D (automatic conversion) ranks first in NPV both overall and with low ZIP+4 usage. Option H (90-10 split procurement) ranks second in NPV overall and third with low ZIP+4 usage. Option E (hedge conversion) ranks third in NPV overall and ties for first with low ZIP+4 usage. Options G (50-50 split procurement) and A (single-line OCR) rank almost identically in overall NPV. Option B (multi-line with ZIP+4) ranks relatively low (6th) in NPV, both overall and with low ZIP+4 usage. Option C (multi-line

without ZIP+4) ranks the lowest in overall NPV, but somewhat higher (4th) in NPV with low ZIP+4 usage. Option A (single-line) ranks the lowest in NPV with low ZIP+4 usage.

The dominance of option D (automatic conversion) can also be illustrated by plotting the cumulative probability distributions of NPV for each option. As shown in figure 14, for any value of NPV (incremental over option F (cancel]), the probability is greatest for option D. For example, for an NPV of \$1 billion, the probability is about 0.9 or 90 percent that option D will exceed that NPV (cumulative probability of about 0.1), about 0.75 that option A will exceed, about 0.7 that option B will exceed, and only 0.5 (or 50 percent) that option C will exceed \$1 billion.

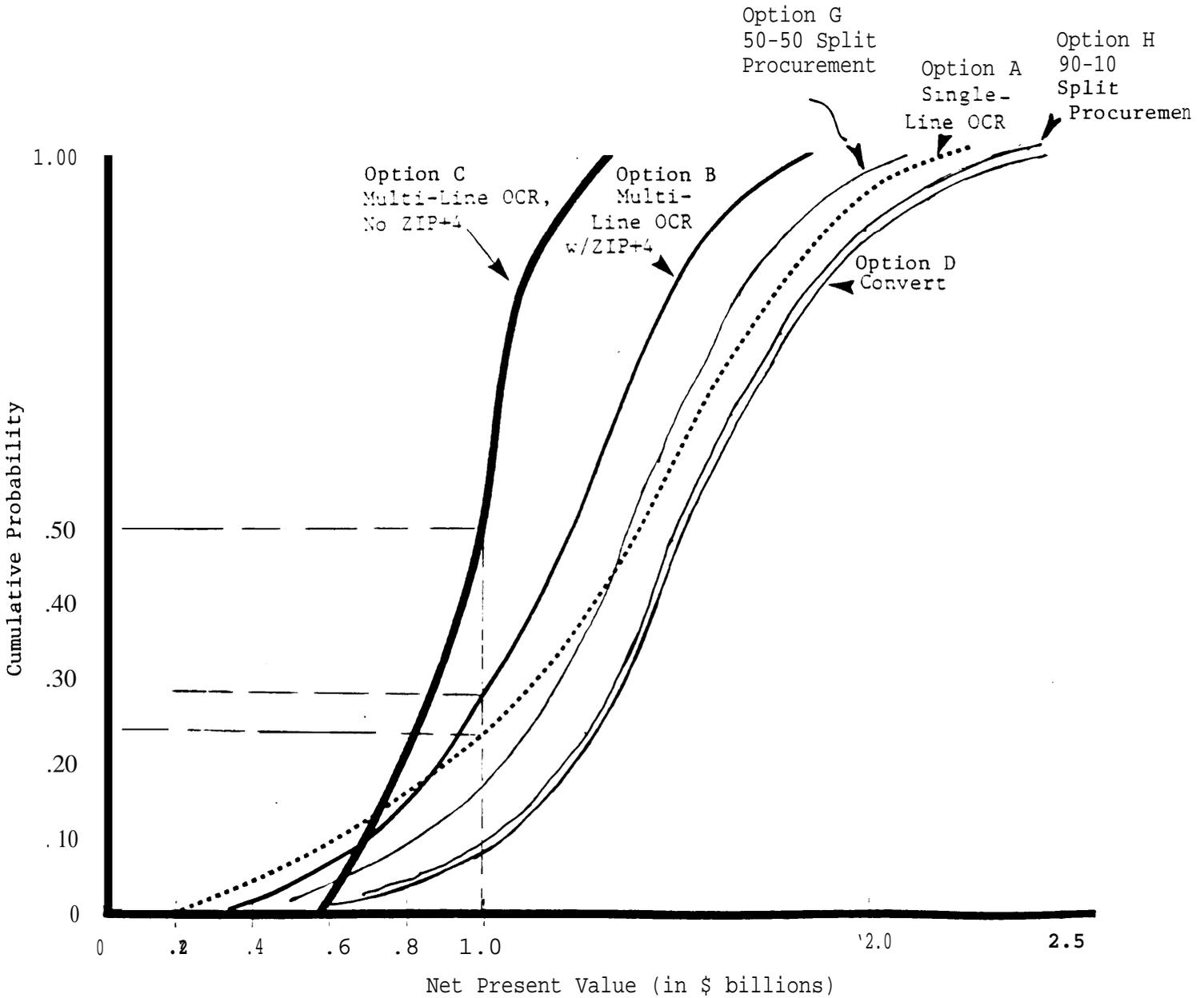
Because option D dominates all other options under all conditions of uncertainty, option D is stochastically dominant.

Supplemental sensitivity analysis. The basic models built in three uncertainties (ZIP+4 usage, savings rate, multi-line performance rate). A supplemental analysis was conducted to check the sensitivity of NPV results to changes in the purchase price of the multi-line OCR or the number of multi-line OCR units.

The results, summarized in figure 15, showed that an increase in multi-line OCR purchase price from \$850,000 to \$970,000 would have very little effect on NPV. The effect would be to reduce NPV by about \$0.02 and 0.03 billion. Likewise, an increase in the number of multi-line OCR units from 403 to 439 (as estimated by GAO to be required if the entire Phase 11 procurement was switched from single- to multi-line OCRs) would cost about an additional \$34.9 million (41 units x 850,000/unit), which is less than the \$40.3 million cost of a \$120,000 price increase for 403 machines. Therefore, the effect on NPV again would be very little.

Figure 14

Cumulative Probability Distributions
of Net Present Value (Smoothed)



Source: Office of Technology Assessment

Figure 15

Sensitivity of Net Present Value
to Multi-line OCR Purchase Cost

NPV* with Different Multi-line
OCR Unit Costs

ZIP+4 Use	Multi-line Performance Rate	Savings Rate	(\$ in billions)			
			@ \$750K	@ \$850K	@ \$970K	
HIGH	High	High	1.88	1.86	1.84	
		Median	1.52	1.50	1.48	
		Low	1.16	1.14	1.12	
	Median	High	1.86	1.84	1.81	
		Median	1.50	1.48	1.46	
		Low	1.14	1.12	1.10	
	Low	High	1.79	1.77	1.75	
		Median	1.44	1.42	1.40	
		Low	1.09	1.07	1.04	
	MEDIAN	High	High	1.57	1.55	1.52
			Median	1.26	1.24	1.21
			Low	.95	.93	.90
Median		High	1.53	1.51	1.49	
		Median	1.23	1.21	1.18	
		Low	.92	.90	.88	
Low		High	1.43	1.41	1.39	
		Median	1.14	1.12	1.09	
		Low	.84	.82	.80	
LOW		High	High	1.22	1.20	1.18
			Median	.97	.95	.93
			Low	.72	.70	.68
	Median	High	1.09	1.07	1.04	
		Median	.85	.83	.80	
		Low	.61	.59	.57	
	Low	High	.72	.70	.68	
		Median	.52	.50	.47	
		Low	.32	.30	.27	

* NPV for option B (multi-line OCR with ZIP+4) adjusted to reflect different purchase costs.

Source: Office of Technology Assessment

In sum, neither a modest increase in price per unit for the multi-line OCRs or in the total number of units would significantly change the NPVs.

Overall and selected year cash flows. Net present value is the best basis for comparative quantitative evaluation of the decision options. However, the actual undiscounted net cash flows over the 13 year payback period (1985-98) can provide another dimension to the evaluation.

Comparative net cash flows for selected options and conditions are shown in figure 16. 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. Yearly cash flows for selected options and conditions are shown in figure 17, for the years 1994-98. By this time, all equipment will presumably have been installed (or converted) and up and running

Figure 16

Comparative Net Cash Flows,
Selected Options and Conditions,
1985-1998 (in \$ billions)

	Option A (Single- line)	Option B (Multi-line with ZIP+4)	Option D (Automatic Conversion)	Option G* (50-50 split Procurement)	Option H* (90-10 split Procurement)
High ZIP+4 Usage High Savings Rate High Multi-line Performance Net Cash Flow Compared to Option A	+\$8.80	+\$8.14 -0.66	\$9.36 +0.56	+\$8.75 -0.05	+\$9.24 +0.44
Median ZIP+4 Usage High Savings Rate High Multi-line Performance Net Cash Flow Compared to Option A	+\$8.24	+\$7.59 -0.65	+\$9.03 +0.79	+\$8.31 +0.07	+\$8.89 +0.65
Low ZIP+4 Usage High Savings Rate High Multi-line Performance Net Cash Flow Compared to Option A	+\$3.57	+\$6.57 +3.01	+\$7.19 +3.62	+\$6.88 +3.31	+\$7.13 +3.56
Low ZIP+4 Usage High Savings Rate Median Multi-line Performance Net Cash Flow Compared to Option A	+\$3.57	+\$5.98 +2.41	+\$6.59 +3.02	+\$6.29 +2.72	+\$6.54 +2.97
Low ZIP+4 Usage High Savings Rate Low Multi-line Performance Net Cash Flow Compared to Option A	+\$3.57	+\$4.38 +0.82	+\$5.00 +1.43	+\$4.69 +1.12	+\$4.94 +1.37

* Options G and H calculated by interpolating between Options B and D.

NOTE: All net cash flow figures in undiscounted dollars.

SOURCE: Office of Technology Assessment

Figure 17

Comparative Net Cash Flows,
Selected Options, Conditions, and Years
(in \$ billions)

	Option A (Single- line)	Options B (Multi-line) D (Automatic Conversion) G (50-50 Split Procurement) H (90-10 Split Procurement)	Options B, G, D, H Compared to Option A
High ZIP+4 Usage High Savings Rate High Multi-line Performance Net Cash Flow			
1994	\$0.87	\$0.94	\$0.07
1995	0.94	1.02	0.08
1996	1.02	1.11	0.09
1997	1.11	1.20	0.09
1998	1.20	1.30	0.10
Low ZIP+4 Usage High Savings Rate High Multi-line Performance Net Cash Flow			
1994	0.43	0.87	0.44
1995	0.46	0.93	0.47
1996	0.50	1.01	0.51
1997	0.54	1.09	0.55
1998	0.59	1.17	0.58
Low ZIP+4 Usage High Savings Rate Median Multi-line Performance Net Cash Flow			
1994	0.43	0.80	0.37
1995	0.46	0.86	0.40
1996	0.50	0.93	0.43
1997	0.54	1.00	0.47
1998	0.59	1.08	0.49
Low ZIP+4 Usage High Savings Rate Low Multi-line Performance Net Cash Flow			
1994	0.43	0.61	0.18
1995	0.46	0.66	0.20
1996	0.50	0.71	0.21
1997	0.54	0.77	0.23
1998	0.59	0.83	0.24

Source: Office of Technology Assessment

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 1994 to 1998. With median multi-line performance, the advantage of options B, D, G, and H 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.