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ABSTRACT

A study was conducted to determine if the centralization of braille operations for the national free library program would be feasible, economical, and desirable. This report presents the findings of the study in three sections. Section 1 provides background information, a summary of the first phase of operations, and the study objective for phase two. The analysis of distribution presented in Section 2 identifies several criteria that were applicable to the determination of the best distribution network for centralized braille operations, the most important criteria being minimization of delivery time of braille books to patrons, minimization of labor costs, and minimization of occupancy costs. It is noted that this determination required the formulation and evaluation of a mathematical model of the network, and an examination of specific, relevant information on potential locations for the center(s). Section 3 presents macro-level operating procedures, workload requirements, resource requirements, and estimated costs for centralized braille operations. Discussions in this section focus on workload requirements; operating procedures; labor requirements and estimated costs; occupancy requirements and estimated costs; and all other requirements and estimated costs. It was concluded that centralized braille operations would enable the national free library program to realize significant cost reductions, and that both service and available book selection would be improved, as well as the control and accountability of the national collection of braille and the accountability of braille circulation. An executive summary is provided, and appended tables, charts, and maps provide statistical profiles related to these issues. (MAB)

PHASE II REPORT VOLUME I

ALTERNATIVE MODELS OF SERVICE, CENTRALIZED BRAILLE OPERATIONS

to:

National Library Service
for the Blind and
Physically Handicapped
Library of Congress

for:

Data Collection Services

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The National Library Service for the Blind and Physically Handicapped (NLS), The Library of Congress, commissioned Technology Management Corporation (TMC) to construct an alternative model of braille book services provided to patrons of the national free library program, and to compare it with existing network operations considering both cost and service. This alternative model was centralized braille storage and distribution operations.

The development of an alternative model of operations focused exclusively upon network operations, and excluded consideration of costs directly incurred by the United State Postal Service, which provides transport of materials for the program, and the acquisition costs directly incurred by NLS for braille books and associated supplies for braille; these costs and operations were outside the scope of the study. Also outside the scope of the study were the methods by which centralized operations, if implemented, would be funded. Finally, the development of an alternative model of centralized operations was a feasibility study, not an implementation study, and as such *detailed* recommendations pertaining to operating procedures, facility configuration, capital equipment requirements and staff composition were *not* developed; however, macro-level requirements and costs for all applicable areas were developed.

An analysis was first performed to determine the best distribution network for centralized braille operations, the primary criterion being the minimization of delivery time to patrons, the secondary criterion being the minimization of labor costs, the tertiary criterion being the minimization of occupancy costs, and an additional, subsidiary consideration of weather conditions to the extent that centralized operations and/or postal deliveries would be impacted. A mathematical profile of the network was developed modeling the geographic distribution of network demand for braille books using braille readership as a weighting factor for the geometric model. Potential locations for braille distribution centers were constrained to the 29 metropolitan areas in which the United States Postal Service has bulk mail facilities, the logic being to facilitate distribution center output entering the bulk mail stream on the same day that orders are picked. A delivery time estimation equation was derived from USPS service standards to model delivery time from various potential supply points to demand points in the network.

It was determined that the braille readership centroid, or "center of gravity," lies in south-central Illinois. The theoretical location that would minimize average national delivery time for

braille was found to lie in south-east Indiana. Knowing both of these locations, it was determined that if a one-center operation were to be established, with the sole location criterion being minimization of delivery time to patrons, then the choice would be reduced to Cincinnati, Ohio; Chicago, Illinois, or; St. Louis, Missouri. However, a one-center operation for braille is absolutely not recommended for risk diversification reasons, i.e., if a catastrophe should occur at a single center facility, the entire national collection of braille books, not in the possession of patrons or in-transit, would be destroyed. Additionally, the maximum delivery time to some regions of the country would be too long to make a one-center operation feasible.

An analysis was then performed for a two-center operation using OPTISITE, a site location optimization computer program, with the selection criterion still being only minimization of average national delivery time. The results of this analysis yielded the most desirable two locations for centers serving eastern and western regions of the country. Denver, Colorado and Salt Lake City, Utah are the best locations for western centers, and Pittsburgh, Pennsylvania and Cincinnati, Ohio are the best locations for eastern centers. Due to the national distribution of demand for braille, the eastern center would be considerably larger (64%), in terms of readership served, than the western center (36%), under operating schemes that minimize average national delivery time. An analysis of the prevailing costs of labor, the prevailing costs of facility space, and the prevailing weather conditions at all four of the sites mentioned above yielded the conclusion that Salt Lake City and Cincinnati would be the optimal locations for situating braille central distribution centers. An analysis of a three-center operation was also conducted, but it was determined that the marginal improvements in average and maximum delivery times were more than offset by reduced efficiencies from increasing decentralization. Additionally, the optimal sites (based on delivery times) selected under the three-center scenario were New York, St. Louis, and San Francisco and both New York and San Francisco have highly unfavorable prevailing labor and facility space costs.

Centralized braille operations would consist of a western center situated in Salt Lake City, UT serving 36% of national braille readership (all states west of the Mississippi River), and an eastern center situated in Cincinnati, OH serving 64% of national braille readership (all states east of the Mississippi River). Due to economies of consolidation, 22% (199,500 volumes) of the national collection of BR books that can be accounted for (906,600 volumes) would not be necessary in centralized operations. Of the projected necessary collection size of 711,900 BR volumes, 40% would be housed in the western center, and 60% would be housed in the eastern center. Of the three existing sets of regular BRA currently housed in the three MSCs, two would be stored in the eastern

center, and one would be stored in the western center. All other braille collections would be stored in the western center. This apportionment scheme optimizes the proportion of BR and BRA books to readers in each of the two regions, while achieving a 48%-West, 52%-East apportionment of the total national braille collection to maximize risk diversification.

The braille centers would be comprehensive service facilities located in warehouses with reader advisory services, and the only braille function that would remain resident at network libraries would be initial registration of braille patrons with the free library program. The centers would have automatic circulation generation capabilities, patrons would send mail-in requests directly to the centers, and phone calls would be placed on "800" lines directly (possibly as a pass-through at the libraries) to the centers by patrons. Input and output functions would be expedited by use of wanding and/or scanning of OCR and/or bar coded braille volumes.

Double-deep rack storage modules with 12-tiers are recommended for stack storage areas, although 7-tier storage is possible as a less-efficient option if a low vertical height warehouse is used. The western center would require approximately 23,160 sf (square feet) and the eastern center 25,380 sf if the recommended 12-tier storage methods are used; otherwise, the respective values are 36,400 sf and 39,800 sf.

TMC concludes that centralization of braille operations for the national free library program is feasible, economical and desirable. Significant cost reductions can be achieved through reduced labor (27% reduction) and "other" costs (20% reduction) due to economies of scale, and through reduced occupancy costs (80% reduction) due to economies of consolidation, lower unit occupancy rates and the application of more efficient storage methods. The quality of service provided to braille patrons of the national free library program would become more uniform, because service would be provided by two service points rather than 40, and available book selection would be improved by pooling the national collection at two locations rather than 40 locations. Additionally, control and accountability of the national collection of braille would be significantly improved. Total network costs for braille operations under a centralized operating scenario would be approximately $1,586,000 per year, which represents a $1,741,000 reduction, or 52% reduction, from current operational costs.

Section 1

INTRODUCTION

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1.1 BACKGROUND

The National Library Service for the Blind and Physically Handicapped (NLS), Library of Congress, administers a free national library program for persons who are unable to read standard printed materials due to physical or visual impairments. In cooperation with authors and publishers of books and magazines, NLS is granted permission to mass-produce copyrighted works. NLS works with a network of state, local and private libraries and agencies, which provides the necessary resources for the storage and distribution of the NLS materials. The books and magazines in braille, recorded disc and recorded cassette format, as well as specially designed playback machines and accessories, are delivered to eligible patrons by postage-free mail, and returned to network libraries and agencies in the same manner.

The free national library program consists of three major components, each with its associated responsibilities, costs and revenue sources. NLS, funded by Congress, secures copyright permission from authors and publishers, contracts with firms for the mass production of braille and recorded books and magazines, machines, accessories, and repair parts, and administers the program. The United States Postal Service (USPS), funded by Congress for this program, provides transport of program materials between and among network facilities, patrons, NLS, and points of book and machine manufacture and repair. The network, consisting of state, local and private libraries and agencies, funded by various combinations of federal, state, local and private sources, provides the personnel, facilities and other resources necessary to provide NLS materials to patrons.

There were four basic types of facilities in the network during federal fiscal year 1989. Regional libraries (RL), of which there were 56, provide a comprehensive range of services, including services in addition to distributing NLS sponsored materials. Subregional libraries (SRL), of which there were 92, provide service to a specified part of a regional library's territory. Machine lending agencies (MLA), of which there were 8, control and distribute NLS machines and accessories to patrons in a specified service area. Multistate centers (MSC), of which there were 3, are NLS agencies that distribute program materials and backup supplies to network libraries and agencies, as well as braille and recorded books from special collections directly to patrons.

1.2 SUMMARY OF PHASE I

In Phase I of the study, Technology Management Corporation (TMC) determined the baseline costs of operations for the network of libraries and agencies that provides braille book services, recorded book services, and playback machine loan services to patrons of the national free library program. In addition to the determination of baseline costs for network operations, a 15-year projection of these costs was also performed.

TMC initially compiled a statistical profile of the network and made a pilot site visit to the Washington, D.C., regional library. With the guidance and approval of NLS staff and an advisory committee composed of network administrators and other interested parties, a data collection plan was formulated, and a representative sample of network sites was selected whose cost behavior was used to model the baseline costs of the entire network population. The data collection plan was designed to capture all relevant costs of operations, including costs associated with labor, facility occupancy, capital equipment depreciation, equipment maintenance, services, supplies, miscellaneous activities and administrative overhead. The sample was designed to include sites which spanned the full range of size for readership, circulation, collection and several other operational attributes, as well as full geographic representation. A total of 35 sites was selected for the sample: 17 regional libraries, 15 subregional libraries and all 3 MSCs.

Study teams consisting of one or two individuals made visits to each selected site for a period of approximately one week for the purpose of data collection, which involved the collection of raw financial and operational data, the interviewing of staff to determine time spent on particular activities, the assessment of facility space and capital equipment utilization, and the determination of the uses of all other resources. The data thus collected was then analyzed and compiled by cost category, e.g., labor, and by operation, e.g., braille book services, taking into account all direct and indirect costs incurred by the sites themselves or any parent or administering organizations that support the operations under study. Costs directly incurred for the provision of specific operations were assigned directly to those operations, while indirect costs were allocated to applicable operations by the most appropriate allocation bases. It was readily apparent at the conclusion of these individual site analyses that labor was the most significant cost category, followed by occupancy costs, and then all other costs.

The projection of baseline network costs was then performed, based upon the cost behavior of the sample sites, operational statistics as reported to NLS by network libraries and agencies, and unit occupancy costs compiled by the General Services Administration (GSA). Independent mathematical relationships relating the costs for the sample sites to their associated operational statistics were developed for regional and subregional libraries for each of the three operations under study, and for three major cost categories; labor, occupancy and all other costs. These cost prediction models assumed the form of both regression equations and step-functions of stratified means, which were then used to predict the costs of sites not visited based upon their reported operational statistics. In the case of occupancy costs, the cost prediction models first determined predicted facility space area (in square feet) and then applied the GSA RENT system unit occupancy costs to determine the full occupancy costs for each operation. For the MSCs, no cost predictions of the population from a sample was necessary because all sites had been visited and analyzed.

TMC found that the approximate costs of network operations for federal fiscal year 1989 (FY89) were $3,154,000 for braille book services, $7,724,000 for playback machine services, $30,181,000 for recorded book services, for a total of $41,058,000 for all three services combined. These figures represent the total expenses incurred by state, local and private libraries and agencies in the network, but exclude both the costs of all books, machines and other materials purchased for the program by NLS, and the costs of all postage-free mailings provided for the program by the United States Postal Service. These costs include all expenses for resources that directly or indirectly support the subject operations, regardless of funding sources, whether directly paid for by the network libraries and agencies, or paid for by parent or administering organizations. In addition to the costs incurred by state, local and private libraries and agencies for network operations in FY89, NLS directly incurred approximately $805,000 in costs for its multistate center operations of which $173,000 was for braille book services, $92,000 was for machine services, $387,000 was for recorded book services, and $153,000 was for publication and back-up supply services. Appendix 1 contains a tabular summary of these baseline costs, further stratified by the three major cost categories.

A 15-year projection of network costs for the three NLS sponsored operations was then performed based upon the baseline costs for the network as determined by the various cost prediction models, NLS estimates of future national readership growth rates, and cost inflation estimates as derived from economic literature. A 2% average annual net growth rate in number of patrons was assumed for recorded books and machines, a 1% average annual net growth rate was assumed for braille books, and a 3.5% average annual cost inflation rate was assumed for all three major

categories of costs that were modeled. Appendix 2 contains the 15-year projection for the combined network and MSC costs of operations for braille services, stratified by cost category.

1.3 PHASE II STUDY OBJECTIVE

The objective of Phase II of the study was to construct two separate alternative models of braille and machine operations for the free national library program, and compare them with existing network operations considering both cost and service. Specifically, these two alternative models are:

(1) Centralized braille storage and distribution operations; and

(2) Centralized machine storage, repair and distribution operations.

The functions that are currently performed and the costs that are incurred by the existing network of libraries, agencies and MSCs for braille and machine operations are detailed in the Phase I, Volume I and II reports, and are summarized in Sections 1.1 and 1.2 of this report. The interested reader is referred to the Phase I report for a detailed description of current service patterns and costs. The remaining sections of this report pertain exclusively to the development of alternative models of operation for braille services. The interested reader is referred to Volume II of the Phase II report for a discussion of alternative models of operation for machine services.

Listed below are five basic tenets regarding the development of alternative models of centralized braille operations during the course of Phase II of this study.

(1) The acquisition costs of NLS provided braille books and associated supplies for braille operations were outside the scope of the study, were not included in the Phase I analysis, and were not included in the Phase II analysis. However, TMC believes that centralization will generally result in *lower* acquisition costs for braille books made possible by enhanced control and inventory management relative to the *status quo*, and also through economies of consolidation of the collection.

(2) The costs of transporting NLS provided braille books and associated supplies, performed by the United States Postal Service, were outside the scope of the study, were not included in the Phase I analysis, and were not included in the Phase II analysis. However, TMC believes that centralization will generally result in *higher* transportation costs for braille books due to longer distance average transits between patrons and supply points, i.e., central distribution centers.

(3) The statement of work for Phase II of the study specifically required the development of *separate* alternative models for centralized braille and machine operations.

Therefore, TMC has *not* modeled *combined* centralized braille and machine operations, although this scenario is certainly feasible, and in fact may even be desirable from the standpoint of operational efficiencies in managerial/supervisory labor costs and ADP equipment costs. If the decision is made to proceed with centralization of *both* operations, this combined operational scenario should be analyzed.

(4) The method(s) by which centralized braille operations would be funded, if centralization is adopted, is outside the scope of this study, and is *not* addressed in this report.

(5) The development of alternative models of centralized braille operations in Phase II of this project was a *feasibility study, not an implementation study*, and as such, *detailed* recommendations pertaining to operating procedures, facility configuration, capital equipment and staff composition are *not* presented. However, macro-level requirements and costs for all applicable areas were developed. TMC strongly urges NLS to perform (internally, or by consultant) an implementation study of centralized operations if the decision is made to proceed with the concept.

Section 2

DISTRIBUTION ANALYSIS

Section 2
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Several criteria were applicable to the determination of the best distribution network for centralized braille operations, the most important criteria being minimization of delivery time of braille books to patrons, minimization of labor costs, and minimization of occupancy costs. This determination required the formulation and evaluation of a mathematical model of the network, and an examination of specific, relevant information concerning potential locations for the center(s).

2.1 PROFILE OF THE NETWORK

Appendix 3 contains a graphical profile of the network which helped in the determination of the locations for braille central distribution center(s). The appendix is a scale map of the continental United States (1/4" = 65 miles), with superimposed Cartesian (x/y) axes, and three types of symbols to indicate modeled points of demand for braille books and potential points of supply, i.e., centers for braille operations.

Points of demand for braille are approximated as being in those metropolitan areas where regional libraries are located, and in the cases of Wyoming and North Dakota (which have no regional libraries), where MLAs are located. Although this is an approximation of national demand distribution, for the purposes of this centralization study the model is more than sufficient. Note that the four regional libraries (Honolulu, Anchorage, San Juan and St. Croix) and one subregional library (Guam) that lie outside the continental United States are not included in the analysis; this omission is deliberate, and the reason is explained in the subsection on delivery times. Demand points are indicated on the map by circles (RL/MLA only) and squares (RL/MLA and postal bulk mail facilities).

The weight assigned to each demand point is the number of braille readers. Deposit collections were assumed to have four readers each, which is the standard NLS approximation. Appendix 4 contains a listing of the network model's demand points, showing the city, state, x coordinate, y coordinate, and braille readership for each demand point. In the cases of North and South Dakota, Michigan, and Pennsylvania, a combined statistic for braille readership was split to assign some weight to each demand point, e.g., two-thirds of Pennsylvania braille readership was assumed to be in the eastern part of the state.

Readership, rather than circulation, was used as the weighting factor in the location analysis for two reasons. First, both TMC and NLS believe reported network readership to be a more accurate statistic than circulation due to some discrepancies among sites with regards to whether copies or volumes of braille are reported. Second, if centralization of braille operations is adopted, the number of braille books circulated per reader will very likely become much more uniform than is presently the case due to a more uniform quality of service that will be provided to patrons relative to the present.

Potential locations for braille distribution centers, for the purposes of this feasibility study, were confined to the 29 metropolitan areas in which the United States Postal Service has bulk mail facilities, be they Bulk Mail Centers (BMCs) or Auxiliary Service Facilities (ASFs). Appendix 5 contains a listing of these bulk mail facilities showing the city, state, x coordinate, y coordinate and type of facility. The decision to constrain the potential supply points to these locations was a directive given by NLS to TMC, and a decision in which TMC concurs, the logic being to facilitate distribution center output entering the bulk mail stream on "day 1". If another choice of locations is made, one of two "penalties" would be incurred; either average braille delivery time would be increased by one-to-two days, or an incremental transportation cost would have to be incurred by the distribution centers to haul the daily output to the nearest city with a BMC/ASF. Cities which have bulk mail facilities are shown in the Appendix ? map as triangles (BMC/ASF only) and squares (BMC/ASF and RL/MLA).

2.2 DELIVERY TIME ESTIMATION

Because minimization of delivery time of braille books to patrons was one objective of the location analysis, a quantitative expression of delivery time had to be derived. Appendix 6 contains a table of published 1989 USPS Service Standards, from which an analytical function of delivery time was derived based upon the standards for Bulk Business Mail. This class of service was used as a surrogate for Free-Matter for the Blind, because a uniform standard had to exist in order for a function to be derived, and Parcel Post service does not possess such a uniform standard. For the purposes of this analysis, the delivery time function derived from the bulk business mail standard was excellent. However, because this time standard is based exclusively upon over-the-road (truck) and by-rail (train) transportation of mail, the delivery time function derived does not apply to delivery of mail to the five geographic outlier points in the network previously cited (the mail goes by ship). For this reason, the geographic outliers had to be excluded from the location analysis.

Appendix 7 depicts the derivation of a univariate, linear regression equation, that is, an equation of the form "y=a+bx", that was derived from the USPS service standard for bulk business mail. Shown in the appendix are the actual days of delivery time, actual miles from point of origin, estimated days of delivery time, the equation itself, and the "R-squared" value, which measures the degree of accuracy of the equation, which is about 92%. This equation, which was employed in the centralization location analysis, is an excellent estimator of average delivery time (in days) as a function of distance from origin (in miles), and is "weak" only in the immediate service range (metropolitan area) of the origin BMC/ASF, where it estimates about 3.3 days where actually only 2 days are required. An estimating equation of this type was essential in order to use a location optimization program that facilitated analysis for scenarios wherein two or more centers are planned.

2.3 BRAILLE DEMAND CENTROID

With a model of the network developed in terms of demand and supply points, and a delivery time function formulated, the next step performed in the distribution center location analysis was the determination of the centroid, or "center of gravity", of national braille readership. This calculation did not depend upon the delivery time function. The centroid of braille readership is simply the weighted average coordinates of all demand points in the network. Appendix 8 contains a map of the continental U.S. indicating the location of the braille readership centroid, marked by the symbol B. The centroid is located in south-central Illinois, with the closest major metropolitan area, and bulk mail facility, being in St. Louis, Missouri.

With the braille readership centroid determined, the next calculation performed was the determination of the specific location where average delivery time to patrons would be minimized. This location could be exactly coincident with the centroid of readership, or could be different, depending upon the nature of the delivery time function, which has both a fixed and variable component, and the distribution of demand in the network.

To perform this calculation, a scale factor was computed which allowed the straight-line distances between potential supply points and demand points to be expressed in terms of over-land miles. The scale factor, computed by comparing the actual over-land distances from St. Louis, MO to 28 other metropolitan areas around the U.S. to the corresponding straight-line distances to these same points, was 1.306; that is, on average, actual over-land distances in the continental U.S. are 30% to 31% longer than straight-line distances, due primarily to transportation impediments such as

mountain ranges and bodies of water. With regards to the map shown in Appendix 3, a quarter inch represents 65 miles in terms of straight-line distance, but 85 miles in over-land distance.

The location for minimization of average delivery time was then determined by calculation of weighted average coordinates based upon the delivery time function and the distribution of demand for braille. This location is indicated on the map in Appendix 8 by the symbol B'. Note that the location of this point is not coincident with the centroid of braille readership. Instead, it is approximately 160 miles further east and 45 miles further north than the centroid of readership, the closest metropolitan areas being Cincinnati, OH and Indianapolis, IN (equal distance). This difference is due to the relative influence of both fixed and variable components of the delivery time function applied to the distribution of national demand. However, the difference in average delivery times between these locations is insignificant (6.1 days versus 6.2 days) and the maximum delivery time is increased (10.4 days versus 11.0 days) as the distance from the supply point to the west coast demand points are increased.

2.4 ONE CENTRAL DISTRIBUTION CENTER SCENARIO

Having determined the centroid of braille readership and the theoretical location for a one-center operation that would minimize average delivery time to patrons, the average and maximum delivery times were calculated for ten cities that both contain USPS bulk mail facilities and are in closest proximity to the centroid and theoretical location for minimum delivery time. This information, along with the average and maximum delivery times for the readership centroid and theoretical location, is shown in Appendix 9. Also shown in Appendix 9 are the values for Seattle, WA and Jacksonville, FL, (both having bulk mail facilities) for comparison purposes only. It is evident from the data that, within this particular sector of the U.S., average delivery time is not overly sensitive to location, e.g., average delivery time varies from 6.1 to 6.6 days among the ten most suitable sites.

If NLS were to establish a single distribution center for braille, without regard to labor and facility space costs, and in a metropolitan area wherein a BMC/ASF is located, the choice should be narrowed to St. Louis, MO; Cincinnati, OH; or Chicago, IL. Cincinnati has the shortest average delivery time (6.1 days) with the maximum delivery time being 11.2 days. St. Louis has an average delivery time of 6.2 days, with a maximum delivery time of 10.1 days. Chicago has an average delivery time of 6.2 days and a maximum delivery time of 10.4 days. It is not surprising that these

three cities would be the most suitable sites for a single center, because they are in closest proximity to both the centroid of readership and minimum delivery time point.

The location analysis for one-distribution center braille operations was developed as a baseline, because a single center is the limiting case in a centralization study, i.e., a one-center operation is the most extreme form of centralization of any operation in any industry. However, a single distribution center operation for braille is absolutely not recommended by TMC, nor deemed desirable by NLS, for one very compelling reason: *if a catastrophe should occur at a single center facility, the entire national collection of braille books, not in the possession of patrons or in-transit, would be destroyed.* For this risk diversification reason, and this reason alone, *two centers* for braille are recommended. Another subsidiary, but nevertheless important reason for having two distribution centers would be to shorten the maximum delivery time to something less than 10.1-to-11.2 days (and, additionally, to shorten the average delivery time). For both of these reasons, the examination of the influence and impact of prevailing labor and facility space costs in different metropolitan areas is postponed until after a two-center location scenario is developed.

2.5 TWO CENTRAL DISTRIBUTION CENTERS SCENARIO

Location analysis for a distribution problem in which two or more centers are planned is a much more complex mathematical problem than that associated with a one center scenario. The reason for this increased complexity is that a large, often enormous, number of supply point-demand point combinations must be evaluated until the best solution to the problem is found.

Therefore, TMC employed the use of OPTISITE, a computer program developed by MicroAnalytic Corporation, which is a general purpose facility location model used extensively by private industry as a decision support tool for minimizing costs and improving service in distribution operations. OPTISITE uses sophisticated optimization algorithms to determine the best solution to distribution problems.

In this application, TMC used OPTISITE to determine the best locations, and several "next best" locations, for positioning two central distribution centers for braille, and to determine which demand points should be served by each of the two supply points. In the process of choosing locations and assigning the readership in various states to each center, the program sought to minimize average delivery time to all patrons nationally (minimizing transportation costs was outside

the scope of the study). The program could not, in this application (for reasons which are not expounded upon here), incorporate the influence of prevailing facility space costs in various geographic locations into the selection process, and does not, in general, have the capability to incorporate prevailing labor costs in various geographic locations into the analysis. For this reason, occupancy and labor costs in the "best" potential cities for distribution center locations were examined after OPTISITE made its selections of locations. This is the reason that two-center scenarios other than the optimal set of locations were also derived in the analysis. Additionally, "optimal" may mean that one combination of sites has an average national delivery time of only 0.1 days less than the next best combination of sites, a margin which is less than the standard error of estimation used in the modeling, and a margin that is realistically insignificant. Despite these limitations, OPTISITE proved to be an extremely valuable tool in the initial steps of the two-center analysis, because manual methods of analysis are grossly inadequate.

The same network problem that was modeled in the one-center scenario was modeled by OPTISITE, that is, each demand point was considered to be located in each metropolitan area wherein an RL and/or MLA is located (in the continental U.S.) with readership used as a weighting factor, and with the delivery time function as derived from USPS service standards. In its computations, OPTISITE applied optimization algorithms and proceeded through hundreds of iterations of supply point-demand point assignments in order to determine the best solution, i.e., those central sites and workload splits that minimize average national delivery time. Various combinations of "next best" sets of sites and workload splits were also calculated by the program. Additionally, a separate analysis was performed for a scenario wherein the workload for the nation was split more or less evenly between centers.

The important findings of the two-center analysis are summarized below, and presented in a table in Appendix 10.

1. The workload of the network is not apportioned evenly to the western and eastern centers due to the distribution of demand in the network, i.e., there is more total demand in the eastern than in the western part of the country. Therefore, the eastern center is sized larger (64% - to - 73% of national demand) than the western center (27% - to - 36% of national demand) for the best and next best scenarios in which average national delivery time is minimized.

2. Average national delivery times (5.3-5.5 days) are reduced by approximately one day from that of a one center operation, i.e., from over six days to over five days, for scenarios that minimize average national delivery time. Average delivery time in the

western region (6+ days) is approximately one day longer than in the eastern region (5+ days) due to the longer over-land distances that must be traversed in the west relative to the east, and due to the distribution of demand within each region.

3. Maximum delivery times (7.2-8.7 days) are reduced by approximately three days from that of a one-center operation (10.1-11.2 days); this is a substantial improvement, and a relatively greater improvement than the reduction in average national delivery time. As expected, the maximum delivery times occur in the western region; eastern region maximum delivery times range from 6.5-to-7.1 days.

4. The states of Minnesota, Iowa, Missouri, Arkansas and Louisiana are in a geographic area which is marginally sensitive to the center of assignment. From the perspective of minimizing both national average delivery time and maximum delivery time (which always falls in the western region), these states should be assigned to the eastern center. From the standpoint of making the workload of the two regional centers more comparable, they should be assigned to the western center.

5. Salt Lake City, Utah and Denver, Colorado are the two most favorable sites for braille centers in the western region, and Cincinnati, Ohio and Pittsburgh, Pennsylvania are the two most favorable sites for braille centers in the eastern region. Appendix 10 presents the important statistics for these sites for each combination of locations, and additionally within each of these combinations, the statistics for the cases when either the western or the eastern center is responsible for the states of Minnesota, Iowa, Missouri, Arkansas and Louisiana. Appendix 11 contains a map of the continental U.S., indicating the locations of these four metropolitan areas and the regions of service for each center..

6. An additional scenario was examined whereby the western and eastern centers would be sized approximately equally in terms of workload. Appendix 12 contains a map of the continental U.S. indicating the states that would fall into the western and eastern regions and the centroid of demand for each region. Also indicated on the map are the two most favorable locations for such an operation considering both average and maximum delivery times; Denver, Colorado in the West, and Washington D.C. in the East. The important statistics for this particular combination of sites are shown in Appendix 13. Although Oklahoma City, Kansas City and Des Moines each have slightly lower average delivery times than Denver, the maximum delivery time of 9.2 days versus 7.9 for Denver makes Denver superior in the West. In the East, Washington D.C. has the lowest average and maximum delivery times.

All of the above findings pertain to the determination of the best eastern and western locations for two-center distribution scenarios for braille operations with respect to delivery times only, and without regard to labor and facility space costs. All of the scenarios for two-center operations depicted in Appendix 10 are very close in average delivery times and maximum delivery times, with the exception of the scenarios wherein Salt Lake City would serve the five states immediately west of the Mississippi River (maximum delivery time equals 8.7 days). Therefore, the final determination

of the best metropolitan areas in which to locate the eastern and western centers relies on an examination of the prevailing costs of labor and facility space in those areas.

2.6 MORE THAN TWO CENTRAL DISTRIBUTION CENTERS

As the number of central distribution centers for braille operations is increased from two-to-three, three-to-four, and so forth, both the average delivery time and maximum delivery time within each service area, and for the network as a whole, decrease. This trend is intuitively obvious, with the limiting case being the existing network of one (or two) supply points in each state. However, the improvement in average and maximum delivery times in a three-center scenario is not as significant as one might think. The best combination of sites derived for a three-center operation is: New York, NY; St. Louis, MO; and San Francisco, CA, with an average national delivery time of 4.8 days and a maximum delivery time of 6.7 days. Furthermore, as the number of central distribution centers is increased from one-to-two, two-to-three, and so forth, the economies of centralization such as enhanced collection control, supervisory/managerial efficiencies, space utilization, etc. are diminished.

TMC recommends that if NLS adopts the concept of centralization of braille operations, that a two-center operation be implemented. As shown previously in the delivery time analysis, a two-center operation should yield average delivery times of 5.3-5.5 days, with maximum delivery times of 7.2 - 7.6 days (applicable to a very small percentage of readership). This number of centers will maximize the potential efficiencies of centralization, while providing risk diversification by having braille collections housed in more than one physical location.

2.7 PREVAILING LABOR COSTS

The next step performed in the distribution analysis was an examination of the prevailing costs of labor in those metropolitan areas that have postal bulk mail facilities, and more specifically, in those five metropolitan areas that are the most favorable locations for situating central distribution centers with regards to minimizing average and maximum delivery times of braille books to patrons. These five metropolitan areas are: Denver, Colorado; Washington, D.C.; Cincinnati, Ohio; Pittsburgh, Pennsylvania; and Salt Lake City, Utah. For this examination, macro-level measurements of labor costs were desired, not labor costs associated with specific occupations. Three potential measures of

labor costs were identified, with one of these three clearly being the most representative, timely and comprehensive measurement to use for the purposes of the analysis.

The U.S. Bureau of the Census compiles a statistic called "Per Capita Money Income for 50 Largest Cities." These statistics were examined, but discarded for three reasons. First, income includes more than earnings, and it is earnings which must be focussed upon for the comparison. Second, data was lacking for some of the five most favorable sites. Third, the most recent data was for 1985, which is four years older than the data used in Phase I of the study for determination of network baseline costs.

The U.S. Bureau of the Census also compiles statistics called "City Government Employment and Payroll - Selected Large Cities." One specific statistic in this set of data is average earnings, i.e., average wages, which is the measurement needed for the comparison. However, this statistic was also rejected for three reasons. First, wages applicable to city government jobs alone restrict the comparison to a degree that is more than desirable. Second, data was lacking for some of the five most favorable sites. Third, the most recent data was for 1986, which is three years older than the Phase I study timeframe of 1989.

The most representative, timely and comprehensive measurement of macro-level labor costs found is published by the U.S. Bureau of Labor Statistics, and called "Average Annual Pay, By Selected Metropolitan Areas." This statistic was compiled for 1987, indicates average earnings by metropolitan area, and was available for all five of the most suitable locations for centers and for 24 of the 29 metropolitan areas that have bulk mail facilities. This data is shown in Appendix 14, sorted in ascending order of average annual wage, along with the relative ranking (relative to the average wage for all 24 known cities) for each metropolitan area, and with the values for the five most suitable sites highlighted. The following two conclusions can be deduced from examination of the data in Appendix 14:

- With regards to the distribution center for the West, Salt Lake City, Utah is clearly more desirable than Denver, Colorado. Although Denver is only 3% above average labor cost for all 24 cities compiled, Salt Lake City is 14% below the average labor cost, and in fact, is the lowest of all 24 cities. On a direct comparison basis, average wages are 20% higher in Denver than they are in Salt Lake City.

- With regards to the distribution center for the East, Pittsburgh, Pennsylvania and Cincinnati, Ohio are very close in value, and hence of virtually equal desirability.

Pittsburgh is 5% below average wage for all 24 sites compiled, and Cincinnati is 4% below the average. On a direct comparison basis, Cincinnati's average wage rate is 0.9% higher than Pittsburgh's average wage rate. Washington D.C., which is a desirable location only for the Denver-Washington equal workload scenario, is very undesirable with regards to labor costs; Washington is the third most expensive labor site of the 24 sites examined, and is 20% and 19% higher than Pittsburgh and Cincinnati, respectively.

2.8 PREVAILING OCCUPANCY COSTS

The final step performed in the distribution analysis was an examination of the prevailing costs of facility space in those metropolitan areas with postal bulk mail facilities, and in particular, Denver, Washington, Cincinnati, Pittsburgh and Salt Lake City. The type of facility space appropriate for an operation such as centralized braille storage and distribution is warehouse space. This category of space is different from that employed by many (but not all) of the library sites visited in Phase I of the study, but is nevertheless the appropriate category of space to plan for in a feasibility study such as this. The envisioned centers would be large-scale storage and distribution operations, and although there is no intrinsic reason that walk-in patrons could not be accommodated in such a scheme, "library space", as defined in the Phase I report, is unnecessarily expensive for the intended purposes of the centers.

Consistent with the approach used in Phase I of the study for the determination of the unit occupancy costs of library facility space in various geographic locations, TMC used information provided by the United States General Services Administration's (GSA) RENT system database. This database contains the fully loaded (space, utilities, maintenance and security) unit occupancy costs of all warehouse space managed by GSA in various metropolitan areas around the country. Unlike library space unit occupancy costs, which were calculated as 75% of office space rates, warehouse space costs are determined directly from appraisal by private, professional real estate appraisers, i.e., it is considered by GSA to be, like office space, a fundamental category of facility space.

Appendix 15 contains a listing of average unit occupancy costs (dollars per square foot per year) for 24 of the 29 cities in which the USPS has bulk mail facilities and in which GSA manages warehouse facilities. The listing has been sorted in descending order of unit occupancy cost, with an additional column showing the relative ranking of each city's unit cost to the average unit cost for all 24 known sites. The data for the five cities that are the most suitable sites with regards to

delivery time minimization are highlighted in this listing. The following two conclusions can be deduced from examination of data in Appendix 15:

- With regards to the distribution center for the West, Salt Lake City, Utah is clearly more desirable than Denver, Colorado. Although Denver is 17% below average cost for all 24 cities compiled, Salt Lake City is 35% below average cost. On a direct comparison basis, average warehouse space costs are 27% higher in Denver than they are in Salt Lake City.

- With regards to the distribution center for the East, Cincinnati, Ohio is clearly more desirable than Pittsburgh, Pennsylvania, with a cost 25% below average cost for all 24 cities compiled. Pittsburgh's unit cost is 16% above average cost for the 24 cities, and is 55% higher than Cincinnati's unit cost on a direct comparison basis. Washington D.C., which is a desirable location only for the Denver-Washington equal workload scenario, is undesirable with regards to facility space cost; Washington's cost is 20% above average cost for the 24 sites compiled, and is 61% higher than Cincinnati's cost on a direct comparison basis.

2.9 BEST CONFIGURATION FOR CENTRAL DISTRIBUTION

The important criteria applied in the distribution analysis were the minimization of delivery time of braille books to patrons of the free library service, the minimization of labor costs, and the minimization of facility space costs, in that order of importance. Additionally, potential distribution center locations were constrained to the 29 metropolitan areas wherein USPS bulk mail facilities are located. Furthermore, a one-center scenario was discarded for risk diversification reasons, and a scenario with three or more centers was discarded because the marginal improvements in average and maximum delivery times are more than offset by decreasing economies of decentralization, with the limiting case being one or two distribution centers in every state.

If NLS adopts the concept of central distribution for braille books, TMC recommends that the western center be situated in Salt Lake City, Utah and that the eastern center be situated in Cincinnati, Ohio. This combination of sites is the best configuration for central distribution, all relevant constraints and objectives considered. This recommendation, and the analysis supporting the conclusion, was in no way influenced by the fact that NLS currently operates two of its three MSCs in these locations. Rather, TMC believes that NLS made a prudent choice when it decided years ago to situate MSCs in these locations. Nor is this recommendation influenced in any way by the fact that the Utah regional library, situated in Salt Lake City, currently acts as a *de facto* central

distribution center for braille for eleven western states (including Utah); Salt Lake City is simply an ideal location for the western center, all things considered.

TMC believes that there is absolutely no compelling or intrinsic reason why the centers for the western and eastern regions should be sized equally in terms of readership served. As shown in the analysis, the best combination of sites for an equal workload scenario would have Denver, CO serving as the western site and Washington, D.C. as the eastern site. This operational scenario would be considerably more expensive than the recommended combination of sites, and would also increase both average and maximum delivery times relative to the recommended combination.

One additional factor that was not a major consideration in the distribution analysis was prevailing weather conditions at potential sites, both because only the primary (delivery time) and secondary (cost) factors were scrutinized in the distribution analysis, and because over-land transportation of the mail (especially by rail) is generally not as sensitive to harsh weather conditions as is the case for mail transported by air. Prevailing weather conditions at potential distribution sites should, however, be considered a tertiary factor in the location of centers. With regards to prevailing weather conditions, Salt Lake City is generally more favorable than Denver, and Cincinnati is generally more favorable than Pittsburgh.

There is one somewhat discretionary decision that NLS must make if the two-center, Salt Lake City-Cincinnati recommendation is adopted: should Salt Lake City, or Cincinnati, service the states of Minnesota, Iowa, Missouri, Arkansas, and Louisiana? The trade-off in this decision being a greater share of total national workload for Salt Lake City (36% versus 27%) versus an increased maximum delivery time (8.7 versus 7.6 days) and average delivery time (6.6 versus 6.3 days) for western region patrons (eastern region maximum and average delivery times are virtually unchanged by this variation in workload split).

Section 3

CENTRALIZED BRAILLE OPERATIONS

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In this section of the report, macro-level operating procedures, workload requirements, resource requirements and estimated costs for centralized braille operations are presented. The discussion is presented in six parts in the following order: workload requirements; operating procedures; labor requirements and estimated costs; occupancy requirements and estimated costs; all other requirements and estimated costs, and; conclusions.

3.1 WORKLOAD REQUIREMENTS

The mission of the envisioned braille central distribution centers is to store the national collection of braille and to distribute braille to patrons of the national free library program. Based upon the distribution analysis detailed in Section 2 of this report, the best central distribution configuration for braille would be to have two centers, one located in Salt Lake City, Utah, and the other located in Cincinnati, Ohio. This conclusion was based upon the constraint of locating the centers in metropolitan areas with postal bulk mail facilities, with the primary objective of minimizing delivery time of braille to patrons, the secondary objective of minimizing operating costs, and a tertiary consideration of prevailing weather conditions to the extent that delivery times and/or distribution operations would be impacted. Workload can be categorized into three major components which are discussed in the following order; readership to be served, circulation to be generated, and collections to be housed.

Readership to be Served

National braille readership in federal FY 1989 as reported by network libraries was 19,129 patrons. This total was derived by adding to the total number of reported individual patrons an additional component of four times the number of reported braille deposit collections, which is the standard NLS approximation. As detailed in Section 2 of this report, it was shown that under the optimal operating scenario the eastern center would be considerably larger than the western center, in terms of number of patrons served, due to the geographic distribution of braille readership. It was furthermore shown that the five states immediately west of the Mississippi River could be served by either center with marginal impact on national delivery time, the relevant tradeoff being a reduction in maximum delivery time in the western region versus load leveling of operations at both centers.

Ultimately, if the concept of centralization is adopted and implemented, NLS and the network must decide upon this variation in workload split. For the purposes of this feasibility study, TMC has assumed that the western center would service these five states, resulting in a 36% - West/64% East workload split rather than a 27% - West/73%-East workload split. If patrons are granted at least a 10 book, preferably a 20 book, or even an unlimited book outstanding limit, the increase of one day in maximum delivery time should be realistically insignificant (furthermore, this increase in maximum delivery time really applies only to the states of Arkansas, 7.8 days, and Louisiana, 8.7 days). Under this assumption, the western center would serve 6,889 patrons, and the eastern center would serve 12,240 patrons, based upon FY 1989 workload (reference Appendices 4 and 10).

Circulation to be Generated

As mentioned in Section 2 of the report, reported network readership was focused upon as the primary workload factor in the distribution analysis because it was considered to be a superior statistic to reported braille circulation. The readership statistics are not perfect; some readers are inactive, and some deposit collections may have more (less likely) or fewer (more likely) than four readers per institution. Current national readership figures as used in this analysis are, therefore, probably conservative, but just how conservative they are is impossible to say without further study directed specifically towards verification of these statistics.

However, the accuracy of reported network braille circulation is far more suspect than reported network readership for one very simple reason: some libraries are reporting *volumes* of braille circulated, as they have been requested to do by NLS (with the exception of MSCs, that report titles, i.e., copies), while some are reporting *copies* of braille circulated. Because there are on average approximately three volumes of braille per copy, the result is that national reported circulation of braille is a mixture of these two units of measure. The same problem also exists regarding reported braille collection size; in the case of collection size, NLS requests *titles* and *volumes* from network libraries, and while titles are generally reported accurately, some libraries report collection volumes while others report collection copies, resulting in a mixed statistic of national collection size. In the Phase I analysis, through scrutiny of collection statistics taken in tandem with actual facility space utilized for collection storage at visited sites, along with telephone calls to non-visited braille libraries, TMC was able to greatly improve upon the accuracy of the size of the current national braille collection. Unfortunately, the degree of improvement in the accuracy of current national braille circulation was not as great as that for collection size.

If composite national braille circulation statistics as compiled by NLS for FY89 were accepted without reservation, the following conclusion would be drawn:

- o libraries circulated 261,260 volumes to individuals,
- o libraries circulated 10,872 volumes to deposit collections,
- o libraries circulated 10,460 volumes on interlibrary loans,
- o MSCs circulated 13,000 titles (copies) on interlibrary loans (includes BRA and special collections),
- o total national braille circulation is 321,592 volumes, or 107,197 copies, and
- o *average circulation per braille reader is 5.6 books (copies) per year.*

TMC believes that, based upon verified braille circulation statistics from some of the visited regional library sites, the value of 5.6 braille books per reader per year is unrealistically low. Within this set of verified sites, circulation per reader varies from a *low* of 5.5 to a high of 17 books per reader per year.

If a more uniform circulation reporting and tracking system is employed via central braille distribution, NLS will find that current braille circulation averages approximately 10 books (copies) per reader per year, as readership is currently defined. For those readers of this report who believe that this ratio is too low, keep in mind that the national readership figure of 19,129 is conservative both due to the assumption of four readers per deposit collection, and due to inactive readers that are still counted as active, which could mean that circulation per actual active reader is really more like 13-15 books per reader per year.

Under the 10 copies per reader per year/19,129 readers assumption, current national braille circulation from libraries and MSCs is 191,290 copies per year, or 573,870 volumes per year, which is 78% higher than the total figure previously cited from compiled FY 1989 NLS statistics. This is TMC's best estimate of current national braille circulation; a truly accurate total may never be known unless and until braille distribution is centralized. For this reason, circulation of braille simply could neither be used as the primary basis for sizing the required resources for braille centers, nor as the primary basis for the estimation of operating costs for these centers. However, this estimate was nevertheless somewhat useful in some resource sizing and cost estimation. Based upon this estimate,

the western center would circulate 68,864 copies and 206,592 volumes per year, and the eastern center would circulate 122,426 copies and 367,278 volumes per year.

Collections to be Housed

The anticipated braille collection to be housed in the two central braille distribution centers will consist of the titles of BR currently stored in regional and subregional libraries, and the entire BR and BRA collections currently stored in MSCs along with the entire special collections of braille stored in the MSCs. The size of this collection, qualifications to the above statements, and the logic pertaining to the apportionment of the aggregate collection between eastern and western centers, are detailed in the following paragraphs.

Appendix 16 presents various data pertaining to the total historical production of the national collection of BR braille books, target levels for these books under a centralization scheme, and the current reported size of this collection. The data in each column of the table is described below.

- Column 1 - BR title ranges, of which there are nine, numbered 1-999, 1000-1999, etc., through 8000-8999.
- Column 2 - the number of titles actually produced within each title range. The total number of titles in the BR collection is 7,666.
- Column 3 - the average numbers of copies per title that were produced. This number is approximated at 60 per NLS direction, although it has been higher and lower than this in certain years (the numbered BR collection was begun in the late 1960's).
- Column 4 - the number of copies (books) produced in each title range. The total number of BR copies produced was about 460,000.
- Column 5 - the average number of volumes per copy is assumed to be three, which is the standard NLS approximation.
- Column 6 - the number of volumes produced in each title range. The total number of BR volumes produced was about 1,380,000.
- Column 7 - the target number of BR copies per title for each title range that should be retained under a central distribution scheme of operation per NLS recommendation. This frequency distribution both recognizes that there is much lower demand for older titles than for the most recent titles, and recognizes that if collections are consolidated at two centers, the number of copies per title of the oldest books can be drastically reduced with absolutely no reduction in the quality of service to patrons. The simple fact of the matter, verified without exception by every library visited in the study

sample, is that the older the books, the lower the circulation. A totally objective determination of an optimal frequency distribution of copies per title range is impossible, since this would require a knowledge of national historical demand by title range, and this is data which simply does not exist: the target levels were established by NLS staff using their best judgement based upon experience. TMC believes that the basic form of these target levels are realistic, logical, and would in no way lessen the availability of books to patrons; on the contrary, the pooling of the national collection in two locations would enhance availability to patrons.

- Column 8 - the target number of BR copies for the national collection under central distribution, which is approximately 237,000 copies. This number is 22% below the current national collection of BR in libraries and MSCs, which is about 302,000 copies.

- Column 9 - the target number of BR volumes to be housed in the two braille centers, which totals about 712,000 volumes. This is 22% below the current BR collection in libraries and MSCs, which is about 906,600 volumes.

Appendix 17 presents various data pertaining to the current size of BRA and special collections currently housed in the three MSCs that would be entirely housed in the braille distribution centers. There are six basic collections currently stored in MSCs; Post-13,000 BRA (119,700 volumes), BRA reserves (17,600 volumes), BRA masters (29,500 volumes), Pre-13,000 BRA (63,000 volumes), BRF (12,700 volumes) and BRJ (16,800 volumes). Shown in the appendix are the linear feet of storage shelving used for each collection, the average storage density in volumes per linear foot, and the estimated total volume count, for each MSC and in t . The total size of all six of these collections is approximately 260,000 volumes.

Two additional points need to be addressed regarding the apportionment of the national collection of braille under central distribution. The first issue is whether or not it would be possible for regional libraries that carry braille, and the three subregional libraries in the network that carry substantial quantities of braille, to retain very small "depository collections" at their facilities. The answer is an unambiguous "yes"; the data in Appendix 16 shows that the total collection of BR to be stored in the central distribution centers is 711,900 volumes, or 237,300 copies, and the total BR collection that can be accounted for is 906,600 volumes, or 302,200 copies, which leaves 64,900 copies, or 194,700 volumes for other disposition. These volumes are, of course, from the older title ranges. If network libraries desire more recent works in these depository collections, they could either borrow them from the braille centers as a patron would, or coordinate with NLS for increased production runs for a very small number of newer titles that could be permanently housed in library depository collections. However, these two methods of structuring depository collections, and for that

matter the appropriateness of their very existence, are implementation issues which are not addressed any further in this centralization feasibility study.

The second point concerns whether the proposed national collection of braille under central distribution should be split evenly between centers, to maximize risk diversification, or to apportion it roughly according to the ratio of the readership to be served by each center. NLS has made the point to TMC that the collection should be split 50/50 East and West, citing a greater total risk if the collection were split according to readership served (36% West, 64% East), because if the eastern center should burn down, for example, a majority of the collection would be destroyed.

TMC proposes a scenario that maximizes risk diversification of the *entire* national collection, and positions the BR and BRA collections more efficiently in terms of the readership served by each region. This alternative is shown in Appendix 18, the salient points being as follows:

- o split the BR collection 60% East/40% West rather than 50%/50%, for equal risk diversification of BR only, or 64% East/36% West, for proportionate balance with readership,
- o split the regular BRA collection (post 13,000) of which there are three sets, two-thirds East/one-third West, which is virtually in proportion to readership served (it does not make sense to break up these sets any other way), and
- o store all other collections, i.e., BRF, BRA reserve, BRA masters, pre-13,000 BRA, and BRJ in the western center (it does not make sense to fracture any one of these collections, either).

This apportionment of the total national braille collection is optimal with regards to both risk diversification, and balancing the BR and BRA collections in proportion to patrons served within each region. The resulting split would be 464,000 total volumes, or 48%, of the total national collection in the western center, and 507,000 total volumes, or 52%, of the total national collection in the eastern center. There are, of course, only one set each of BRF, BRJ and pre-13,000 BRA collections currently; the only way to substantially reduce risk for these collections would be to have duplicate sets made.

3.2 OPERATING PROCEDURES

In this subsection, operating procedures for the envisioned braille central distribution centers are briefly addressed. As stated earlier in the report, if the concept of centralized braille storage and distribution is adopted by NLS, the performance of an implementation study is essential; in no facet of planning centralized operations is this more true than for the development of best operating procedures. It could be argued, therefore, that operating procedures should not be addressed at all in this feasibility study report. However, TMC believes that the basic framework of central distribution center operating procedures should be established in the feasibility stage of evaluation.

In Phase I of this study, ten fundamental functions were identified which are currently performed in network libraries and/or MSCs that constitute the whole of braille operations. All of these functions would still be required under a central distribution operating scheme. However, it is conceivable that the tasks associated with three of these ten functions could, if desired by NLS and the network libraries, or should, if analysis performed in an implementation study shows that effectiveness and efficiency of overall operations would be enhanced, be partly or primarily performed by regional libraries rather than the braille centers. In the baseline centralization scenario, however, it is assumed that network libraries would be primarily responsible for one function, secondarily responsible for two functions, and not at all responsible for seven functions. These ten functions are discussed below.

Set-up; maintain patron files - *This activity includes the initial registration of patrons with the service, including enrollment in the CMLS direct circulation magazine program, and patron record updates or changes of any kind.*

This is the only one of the ten functions that could, and in TMC's opinion should, remain primarily in the purview of regional libraries. First of all, network library representatives on the advisory committee for the study, as well as directors of libraries visited in Phase I of the study, have expressed a desire to retain a close tie with their patrons by performing this function. Second, most braille readers are also readers of recorded books, simply because the selection of titles is approximately three times that of braille; because recorded book operations are currently envisioned to remain resident at libraries, this function would be essentially duplicated at the centers, and duplication of effort should be avoided. Third, the registration of patrons with CMLS should remain with libraries, because this activity is peripheral to the intended mission of the braille centers.

TMC envisions network libraries performing this task much as they do now, which includes: verification of patron eligibility; entering into a computer database essential patron data such as name, key numeric identifier, address, whether or not the patron desires braille and/or recorded books, and reading preferences, and secondary information such as sex, age, handicap and foreign language abilities; maintenance of the patron file such as changes of address, changes in reading preferences, or if the patron leaves the service for any reason; and CMLS registration. So that this effort is not duplicated at the braille centers, relevant data on new braille patrons enrolled, specifically name, key numeric identifier, address, reading preferences, and foreign language abilities would be telecommunicated or otherwise conveyed electronically in a standard format for compilation on the computer system at the centers. For those patrons already receiving braille service at libraries at the time of conversion to centralization, the previously cited information would be conveyed to the braille centers, along with the braille books that the patron has already read (the "has had" file), the books that the patron currently has in possession (the "now has" file), and the books that the patron has requested but has not been sent (the "reserve" file).

Check-in; shelve - *This activity includes the receipt, sorting, checking-in and putting away of new or returned books.*

This function would be performed exclusively at the braille centers. Because only braille would be carried at the centers, as opposed to recorded books and machines carried at libraries, one primary sort, that of separating braille, recorded books and machines, would be eliminated. Books would be discharged in the receiving area via wanding of bar-codes or OCR codes, simultaneously relieving the patron records of returned books, and adding the returned books to the books available inventory. A temporary holding area should be utilized near the receiving/shipping area for those books that are being discharged that have been selected for pull on the same day, or that are in "backlog", thus minimizing the effort associated with putaway.

Inspect books - *This activity includes the effort associated with book inspection performed upon the issuance and/or the return of books.*

This function would be performed exclusively at the braille centers. This is an activity that accounts for only .6% of total labor costs associated with braille, and virtually all volunteer efforts associated with book inspections is for recorded books, not braille. It is, therefore, a somewhat discretionary activity. Furthermore, it is somewhat inseparable from the "check-in; shelve" and

"check-out; delivery" functions, at least with regards to whether a copy is complete in terms of the number of volumes counted upon receipt or issuance. The other objective of inspection of braille books is to note if binding are coming apart and/or if pages are torn, and flag them for repair, or repair them, if that is the case.

Duplication of books - *This activity includes the reproduction of NLS books.*

This function, to the minimal extent that it occurs, would be performed exclusively at the braille centers - and this is *not* the actual duplication of the braille books themselves, but rather any efforts associated with the retrieval of books from the collections and issuance to firms that actually perform the reproduction, and the subsequent in-checking and put-away of those books. Only the MSCW had any efforts associated with this activity. It is not envisioned that the braille centers would engage in the actual duplication of braille.

Build and maintain collection - *This activity includes weeding and shifting of book collections, the copy allotment process, the ordering of new items, and the processing of book collections.*

This function would be performed exclusively at the braille centers. There are substantial economies to be gained by centralization, for the following reasons: although weeding and shifting would indeed be a substantial task at the centers, due to economies of scale, the total effort associated with this function would be far less than the sum total of the current similar efforts at approximately 40 libraries; processing of new books would occur at two facilities, not 40, and; there would be no copy allotment process - the western center would receive 40% of all new BR produced, 33% of all new BRA regular production, and all new production for the special and master collections, while the eastern center would receive the balance. Even if NLS determines that a different collection apportionment scheme than the one shown in Appendix 18 should be implemented, there is still no copy allotment process, because the split is pre-determined.

Repair books - *This activity includes any repair of braille that is performed.*

This function would be performed exclusively at the braille centers. It includes any repairs needed to the bindings or pages of braille books.

Receive requests, make selections - *This activity includes the receipt of all patron telephone, mail-in and walk-in requests for books, the generation of orders to fulfill these requests, and any reader advisory services or reference work for patrons.*

This is one of the three functions whereby certain tasks could conceivably be performed at libraries, but this function should be the primary responsibility of the braille centers. It is recommended that the braille centers have computer supported automatic circulation generation capabilities that take into account patrons' reading preferences, the books the patrons have previously read, the books the patrons currently have, and the books available for issue. This method of automatic selection should generate a good portion of total braille circulation. With regards to mail-in requests for specific braille titles, these should be mailed by patrons directly to the braille centers. With regards to walk-in patrons in all parts of the country other than those which house the braille centers, any walk-in requests would be forwarded via telecommunication or otherwise electronically conveyed in a standard data format from the libraries to the centers. As to whether or not the centers should provide a reception area and walk-in order capability for patrons living in those metropolitan areas wherein the centers are located, that determination should be left for the implementation study, and hinges on whether or not librarians will be located at the centers for handling telephone requests and providing reader advisory services.

The reader advisory portion of the "receive requests; make selections" function could work one of two ways. The first option would be to have a staff of librarians at the centers to provide reader advisory services, handle telephone orders from patrons, and provide reference services; patrons would either phone the center directly on an 800 number, or phone their home library first and have the call "passed-through" to the center if the call pertained to braille. The second option would be to have no librarians at the centers, with all reader advisory services remaining at the patrons' home libraries, and the network libraries telecommunicating to the centers on a daily basis all orders generated from telephone requests (along with any orders originating from walk-in requests). Which option is preferable simply cannot be absolutely decided in a feasibility study, and must be determined in an implementation study. However, TMC's tentative recommendation is to have a staff of librarians at the centers providing reader advisory services, so that from a patron's perspective (excluding walk-ins) there is one resource point for their braille needs, and so that the centralized service is as comprehensive as possible.

Check-out; delivery - *This activity includes the retrieval of materials from storage locations, packaging and mailing.*

This function would be performed exclusively at the braille centers. Warehouse personnel would pick orders from stock locations in title order sequence, using ladders to retrieve volumes stored over 7' high if a single-level warehouse is used, or without ladders if a two-level, mezzanined or single level, low vertical height warehouse is used. Workload would be evenly apportioned among warehouse personnel in the form of batches of serially printed, title sequenced pick-tickets/address cards. Division of labor could either be structured so dedicated personnel perform retrieval from storage and other personnel package and mail books, or so that warehouse personnel package and mail the same books they retrieve. The issuance step should involve, prior to packaging, "charging" the books out, i.e., wanding a bar-code or OCR-code on both the book volumes and the corresponding order cards to ensure that the correct books have been selected for the patrons who requested them. Pre-sorting of the daily output could expedite delivery times by about one day. The details of this function need to be addressed in an implementation study, especially with regards to the optimal division of labor to specific tasks.

Retrieve overdue items - *This activity includes the writing and mailing of letters, phone calls and home visits to retrieve overdue books from patrons.*

This is one of the three functions that could conceivably be performed by either the braille centers, or by the home libraries of patrons who have books overdue. It is TMC's recommendation that the braille centers assume the primary responsibility of contacting patrons for overdue braille books by letter and by telephone, but not by home visits. However, in special circumstances, especially after repeated unsuccessful attempts by letter and by telephone to obtain long overdue books from patrons, the braille centers should request that the patron's home library make an attempt to obtain the overdue materials.

Manage and support operations - *This activity includes any effort that is managerial or supervisory in nature, clerical and secretarial support, conferences and travel, and the time of any in-house programmer-analysts.*

This function is self-explanatory, and absolutely necessary at both braille centers. Each of the two braille centers would require one overall manager, or director, who would have overall responsibility and authority for each center's operation. Each center would require some clerical and

secretarial support, for reporting requirements, correspondence and miscellaneous duties. The need for designated supervisors below the level of manager is not envisioned; that is true for both the staff of librarians (if reader advisory services are to be available in the centers as is recommended) and for the staff of warehouse workers. Rather, there would be one designated work-leader for each of these staffs, who would spend part of their time scheduling and monitoring the work of others, and the remainder of their time engaged in direct work themselves.

Regarding the requirements for computer systems analysts/computer programmers/computer operators at the centers, TMC envisions, for a baseline scenario anyway, that each center would rely primarily on contracted support for systems analysis and maintenance, programming, and trouble-shooting, while having on staff at least one individual capable of operating the system. This requirement assumes that a "free-standing" ADP system would be resident at each of the two centers (with, as mentioned previously, the ability to transfer patron data, orders and other information between centers and network library ADP systems). However, an alternative which should be evaluated in an implementation study is a free-standing system at only one of the centers, acting as a host system for the other center.

3.3 ESTIMATED LABOR REQUIREMENTS AND COSTS

In Appendix 1 of this report, total current labor costs for braille operations at network libraries as estimated in Phase I of the study is shown to be approximately $1,372,000. With a current national braille readership of 19,129 patrons, this equates to $71.73 per patron served per year. Additionally, approximately $89,000 was expended for labor for braille operations at MCSs; however, for the MSCs, there is no readily available record of how many braille readers were served during FY 1989, but if it is assumed that this expenditure directly or indirectly supported all readers, then a cost of $4.65 per patron per year is derived. The sum of these two per-reader costs is equal to $76.38/reader/year, which is also equal to $1,461,191 (library plus MSC labor costs) divided by 19,129 patrons, and is the current network annual labor cost per braille reader served.

Appendix 19 presents the total labor cost per reader for braille operations, for 1989, for each of the 16 regional libraries visited during the course of Phase I of this study that conduct braille operations. Two sets of data, each containing two statistics are shown in this table: each set of data shows the labor cost per reader and the total readership side by side, with the first set sorted in descending order of cost per reader, and the second set sorted in ascending order of readership. Also

shown in this table are the unweighted average, weighted average and median labor cost per reader for the 16 sites.

As noted in Section 6 of the Phase I, Volume II report (p. 13-14), there were various reasons why the costs of operations, and in this specific case labor costs for braille operations, differed among the sample sites. It was a relatively difficult job deriving the cost prediction model for labor costs in braille operations during Phase I; a step-function of stratified means was used as a predictor rather than a regression equation. However, all potential variations in operating factors not withstanding, examination of the data in Appendix 19 clearly points out a characteristic of labor costs for braille operations, i.e., *economies of scale exist and are significant.* As the second set of data in Appendix 19 shows, with the exception of one and only one site, when braille readership served crosses a threshold of approximately 300 to 350 readers, labor costs per patron drop off dramatically due to economies of scale. In fact, the *highest* labor cost per reader in this group of larger sites is $70.24 per reader per year, which is very close to the *average* cost of all network library sites previously cited ($71.73 per reader). The average (unweighted) cost per reader of those 11 sites with more than 300 readers is $51.34 per reader per year *including* the high cost outlier. This value for the larger sites should be compared to three values shown in Appendix 19 for all 16 sites, which are: the unweighted mean of $93.31 per reader; the weighted mean of $62.58 per reader; and the median of $59.20 per reader.

Appendix 20 shows the current costs and the estimated costs of labor for braille operations under central distribution, based upon readership served, under four reasonable assumptions; the mean and median cost per reader for all 16 regional library sites examined, and the mean and median cost per reader for the 11 sites with more than 300 readers. Under each of these four central distribution estimates, the projected cost is anywhere from 32% to 12% lower than that which is currently incurred by the network. It was assumed in making these estimates that the total labor costs associated with the special collections would remain unchanged.

It can be concluded, that due to economies of scale, total labor costs for centralized braille operations would range from approximately $50.00 to $60.00 per reader per year. TMC's best single estimate of this cost component of operations is $1,071,000 or $56.00 per reader per year, which is a *27% reduction in labor cost* relative to present decentralized operations. This estimate is realistic, not optimistic, considering the prevailing costs of labor in Salt Lake City and Cincinnati, which are

both below the national averages, and the fact that 8 of the 16 regional braille libraries in the sample have per reader labor costs below this value.

3.4 ESTIMATED OCCUPANCY REQUIREMENTS AND COSTS

By far the most significant economies to be gained from braille centralization are savings in occupancy requirements and costs, i.e., savings in facility space and its associated costs. These savings would result for three reasons, which are discussed below.

Economies of Collection Consolidation. Economies of collection consolidation were detailed in Section 3.1 in the discussion of pro-forma workload requirements for the central distribution centers, and pertain to the net reduction of the size of the national BR collection if that collection is pooled at two sites rather than at the current 40 plus sites (the BRA and special collections would remain unchanged). Theoretical consolidation efficiencies of pooling the national BR collection would amount to an approximate 48% reduction of required collection size *if* all BR copies that were ever produced were still in existence. However, because approximately 34% of the copies that were ever produced have either been disposed of or are unaccounted for, actual achievable consolidation efficiencies are approximately 22% (906,600 BR volumes are accounted for currently, and 711,900 BR volumes would be required in the two centers; ref. Appendix 16).

Lower Unit Occupancy Costs. The envisioned braille central distribution centers would utilize warehouse space for their operations, not library space. The relatively lower unit occupancy costs (dollars per square foot per year) for warehouse space would result in substantial savings relative to the *status quo*. Appendix 15 indicates that current unit occupancy costs for warehouse space in Salt Lake City and Cincinnati are $3.46 and $3.97 per square foot per year, respectively. These costs are considerably below the typical costs for library space (ref., Phase I, Volume I report, Appendix 5).

More Efficient Storage Methods. The book storage method envisioned for the braille central distribution centers is that method currently employed at the MSCs. This method involves storing books 12 levels high (13' clear storage height), and double-deep on 2' deep shelves, thus maximizing vertical storage cube (71% more than libraries) and floor area utilization (42% more than libraries). While network libraries achieve braille storage densities ranging from 7.4 to 14.0 (and average 9.8) volumes per square foot as shown in Appendix 21, MSCs achieve storage densities

almost two-and-a-half times higher than this. TMC has determined that a good average storage density factor to use in planning is about 25 volumes per square foot of floor area, and this would leave about 16% of shelf space for packaging materials and vacancy allowance (i.e., actually closer to 30 volumes per square foot are realistically attainable when shelves are fully occupied), and assumes 3' spacing of ranges in the storage areas rather than 30" as is used in the MSCs.

Facility Space Required for Book Storage

The calculation of required facility space for braille book storage was straightforward after the collection size to be housed (ref. Appendix 18) and book storage methods and attainable storage densities had been determined (ref. Appendix 22). The western center would house approximately 464,000 volumes, and require 18,560 square feet of stack area; the eastern center would house 507,000 volumes, and require 20,280 square feet of stack area. These figures assume 12-level high (13' storage) of book stacks, with order picking from levels 8-12 being performed either from ladders, or a mezzanined configuration whereby no ladders would be used. The details of potential storage configurations need to be more fully developed in an implementation study if the centralization concept is adopted.

In a very conservative scenario whereby books are stored on one floor level only to a height of 8' (7-levels) whereby ladders are not used at all, required stack area would be 31,800 square feet for the western center, and 34,700 square feet for the eastern center. This method makes very poor use of air-rights, but is possible, and would be essential if a building with low ceiling height is used.

Current BR production averages approximately 350 titles per year, which at 60 copies per title equates to 21,000 copies, or 63,000 volumes per year that would be added to the national collection. Over a 5-year time frame, these additions would amount to *315,000 new volumes*, which at 25 volumes per square foot of stack floor area equates to a total additional need of 12,600 square feet, of which an additional 5,040 square feet would be required at the western center, and an additional 7,560 square feet would be required at the eastern center. If the less efficient storage method is used, i.e., 7-high storage of books, additional space requirements would be 8,700 square feet at the western center and 13,034 square feet at the eastern center.

However, these figures assume no weeding of the collection as titles age. If the same aging profile specified in Appendix 16 is to hold for the next 5 years, approximately *250,000 volumes*

would be weeded from the entire national collection, making *net growth only 65,000 volumes* over the five year period, requiring only an additional 2,600 square feet in total at both centers using 12-level storage or 4,500 square feet using 7-level storage.

Facility Space Required for Other Than Book Storage

The major essential non-stack areas envisioned for braille distribution centers are receiving and shipping areas, office areas, bathrooms, breakrooms, computer room and office supplies storage (warehouse supplies have been accounted for in stack storage by using storage densities 16% lower than realistically possible for zero vacancy). The specific facility layout and sizing of each of these particular areas must be reserved for an implementation study. The following macro-level measurements have been used to approximate the facility area requirement for these functions:

(1) Per Appendix 21, total non-storage facility area for braille operations averaged 23% (unweighted) to 24% (weighted) of total area used for braille operations among the 16 sample braille regional libraries. TMC believes this ratio is too high, and is distorted by vacant storage area in several libraries; two libraries that serve a large readership and have large collections make do with less than 10% of total area for non-storage activities.

(2) MSC non-storage areas used for braille operations average 14% of the total area associated with braille operations. Of course, reader advisory services and patron registration are not performed at MSCs.

(3) TMC believes that for the purpose of this feasibility study, 20% of total area is a reasonable number to use for estimation of area requirements and costs for non-stack space.

Using 20% of total facility area as a guideline for the total of all non-stack areas, the western center would require about 4,600 square feet of non-storage space, and the eastern center would require about 5,100 square feet of non-storage space. As a check on the "reasonableness" of these estimates, the following estimates were assumed for the facility areas required for the specific functions previously listed as being necessary for non-storage areas: office area, 2,000 square feet; bathrooms, 400 square feet; breakroom, 500 square feet; computer room, 200 square feet; receiving/shipping area, 2,000 square feet; office supply storage, 100 square feet, and; total area, 5,200 square feet. Therefore, it appears that the 20% of total area approximation is reasonable, based both upon a baseline development of requirements from component functional areas, and from an examination of current practices.

Total Estimated Occupancy Requirements and Costs

Appendix 23 contains the estimated facility space requirements and costs for both the eastern and western braille distribution centers, and in total. These costs should be compared to the current estimated occupancy costs for the network of $1,461,000 per year; *occupancy costs under a centralization scheme would range from 12.5% to 19.5% of total existing occupancy costs for the network.* To review the reasons for these enormous savings, consider the following:

(1) *Economies of consolidation* would reduce the collection to be housed by 22%, the efficiency factor being 1.28.

(2) *Improved storage methods* would increase collection storage density from approximately 9.7 volumes per square foot (network average) to about 25 volumes per square foot (and leave room for packaging material storage and vacancy allowances) for 12-level/13' storage, or to about 14.6 volumes per square foot for 7-level/8' storage, the efficiency factors being 2.5 and 1.5, respectively.

(3) *Lower unit occupancy costs*, in the order of $3.50 to $4.00 per square foot per year, versus library space costs in the order of at least $10.00, result in an efficiency factor of 2.5.

(4) The net result is a combined efficiency factor of 1.28 x 2.5 x 2.5 = 8, or 1.28 x 1.5 x 2.5 = 4.8, hence the net reduction in occupancy costs to 1/8-to-1/5 of current levels.

3.5 ESTIMATED OTHER REQUIREMENTS AND COSTS

Other requirements for braille operations consist of capital equipment, maintenance of equipment, various services, supplies, travel and miscellaneous needs, and administrative overhead. The total network costs for these resources were estimated in Phase I of the study to be approximately $418,000 per year, which is only 12.6% of total braille operations current costs. Due to economies of scale, this figure can be considered an "upper bound" for centralized braille operations, i.e., it would be highly unlikely for the costs associated with these resources in a centralized operation to exceed the current network-wide costs.

The extrapolation of costs for any particular individual resource category from sample site data was complicated by the various factors detailed in the Phase I, Volume II report, pages 13-14. This is especially true of equipment depreciation, office services and equipment maintenance, because some

sites owned and operated their own ADP systems, while other sites were supported by parent or external organizations.

Therefore, a baseline development of other resources and costs was made. It must be stated unambiguously here that the following estimates are *macro-level approximations*, not detailed resource requirements and costs. It is simply inappropriate in this feasibility study to attempt a detailed calculation of costs for each category. specify manufacturers and models of capital equipment and other details that are the very substance of an implementation study. Furthermore, because the potential sampling error in the Phase I analysis was ± 10%, which amounts to $40,000 for braille operations other costs (all MSCs were visited, otherwise it would be $42,000), an estimate of these other costs that is too high or too low by several tens of thousands of dollars is statistically insignificant.

With the above caveats and qualifications stated, listed below are macro-level requirements and cost estimates for centralized braille operations other costs. In most instances, cost approximations were made based upon actual expenditures by large braille libraries and extrapolated on the basis of readership served.

- Automatic Data Processing (ADP) Equipment. It is assumed that each center would have a free-standing ADP system, and the acquisition cost of the system (including all peripherals, terminals, telecommunications hardware etc..) for each center would be $200,000. Assuming that the systems have ten-year estimated useful lives, which was the assumption used for major computer systems in the Phase I analysis, the average annual cost associated with the purchase of the ADP systems is **$40,000.**

- ADP Systems Maintenance and Support. As was described in Subsection 3.2 of the report, it is assumed that all systems support, maintenance, programming and troubleshooting would be provided by contractor support. The approximate cost of these services are assumed to be $20,000 at each center, or **$40,000** per year in total.

- Storage Racks. The combined storage requirement at both centers is 971,000 volumes of braille books, which at 5 volumes per linear foot will require 194,000 linear feet of shelving. Using the same depreciation cost for shelving (MSC type industrial shelving) that was used in Phase I of the study, $0.072/LF/year, an average annual cost of **$14,000** is calculated.

- All Other Capital Equipment. It is assumed that the average annual depreciation of all fixed assets other than ADP equipment and shelving would be approximately **$10,000** per year. This estimate is probably conservative, not liberal.

- Supplies. The total estimated cost for operating supplies for both centers would be approximately **$35,000** per year, which includes all office and warehouse supplies that were costed in the Phase I analysis. This cost excludes mailing boxes for braille books and any other supplies which are NLS furnished, which were outside the scope of the study, and were not costed in the Phase I analysis.

- Equipment Maintenance and Rental for Non-ADP Hardware. The estimated cost for all non-ADP equipment maintenance and/or rental at both centers is **$8,000** per year. A good portion of this, 50%-75%, would be for photocopy equipment rental and maintenance.

- Toll-Free Phone Lines. Toll-free, i.e., "800" number, telephone line costs would be approximately **$40,000** per year for both centers.

- Telecommunications. There is a requirement that network libraries convey electronically to the braille centers data on new patrons added to the service, patrons to be deleted and orders placed by walk-in patrons. Other than this modest requirement, there are no other requirements for telecommunications between libraries and centers. Likewise, the only telecommunication requirement between centers would be for inter-center loans. This cost, which excludes hardware (which was included in the ADP estimate), is assumed to be **$10,000** per year.

- Travel. Travel costs are approximated at $5,000 per year per center, or **$10,000** per year in total.

- Miscellaneous. Miscellaneous costs are approximated at $10,000 per year per center, or **$20,000** per year in total.

- Administrative Overhead. The same general rule was applied for the estimate of administrative overhead for centralized operations as was true for the Phase I analysis when actual administrative overhead was unknown, i.e., 10% of loaded labor. Therefore, approximately **$107,000** per year would be incurred for administrative overhead support. This estimate may be conservative, considering that MSC parent organizations only charge NLS about 4% to 5% of loaded labor costs, but for the sake of consistency, it is the estimate used here.

Given the above macro-level estimates by cost category, total non-labor, non-occupancy costs for centralized braille operations would be approximately **$334,000** per year. *This is a net reduction of $84,000 per year, or 20%, relative to present network operations.*

3.6 CONCLUSIONS REGARDING CENTRALIZED BRAILLE OPERATIONS

TMC concludes that centralization of braille operations for the national free library program is feasible, economical and, desirable. Significant cost reductions can be achieved through reduced

labor and "other" costs due to economies of scale, and through reduced occupancy costs due to economies of consolidation, lower unit occupancy rates and the application of more efficient storage methods. The quality of service provided to braille patrons of the national free library program would become more uniform, because service would be provided by two service points rather than 40, and available book selection would be improved by pooling the national collection at two locations rather than 40 locations. Additionally, control and accountability of the national collection of braille would be significantly improved, as would the accountability of national braille circulation. Total network costs for braille operations under a centralized operating scenario would be approximately $1,586,000 per year, which represents a $1,741,000 reduction, or 52% reduction, from current operational costs.

APPENDICES

Appendix 1

BASELINE NETWORK COSTS

Libraries and Agencies

Cost Category	Braille Books	Playback Machines	Recorded Books	Supplies	Total Cost
Labor	$1,372,149	$5,014,594	$16,080,128	----	$22,466,871
Occupancy	1,384,705	1,350,764	8,588,514	----	11,323,983
All Other	397,201	1,358,216	5,512,136	----	7,267,553
Total Cost	$3,154,055	$7,723,574	$30,180,778	----	$41,058,408

Multistate Centers

Labor	$89,043	$45,067	$234,153	$81,397	$449,660
Occupancy	63,021	38,654	95,980	57,424	255,079
All Other	20,662	8,564	56,835	14,493	100,554
Total Cost	$172,725	$92,285	$386,969	$153,314	$805,293

Total: Libraries, Agencies & MSCs

Labor	$1,461,191	$5,059,661	$16,314,281	$81,397	$22,916,531
Occupancy	1,447,726	1,389,418	8,684,494	57,424	11,579,062
All Other	417,863	1,366,780	5,568,972	14,493	7,368,108
Total Cost	$3,326,781	$7,815,859	$30,567,747	$153,314	$41,863,701

Appendix 2

15-YEAR COST PROJECTION
BRAILLE

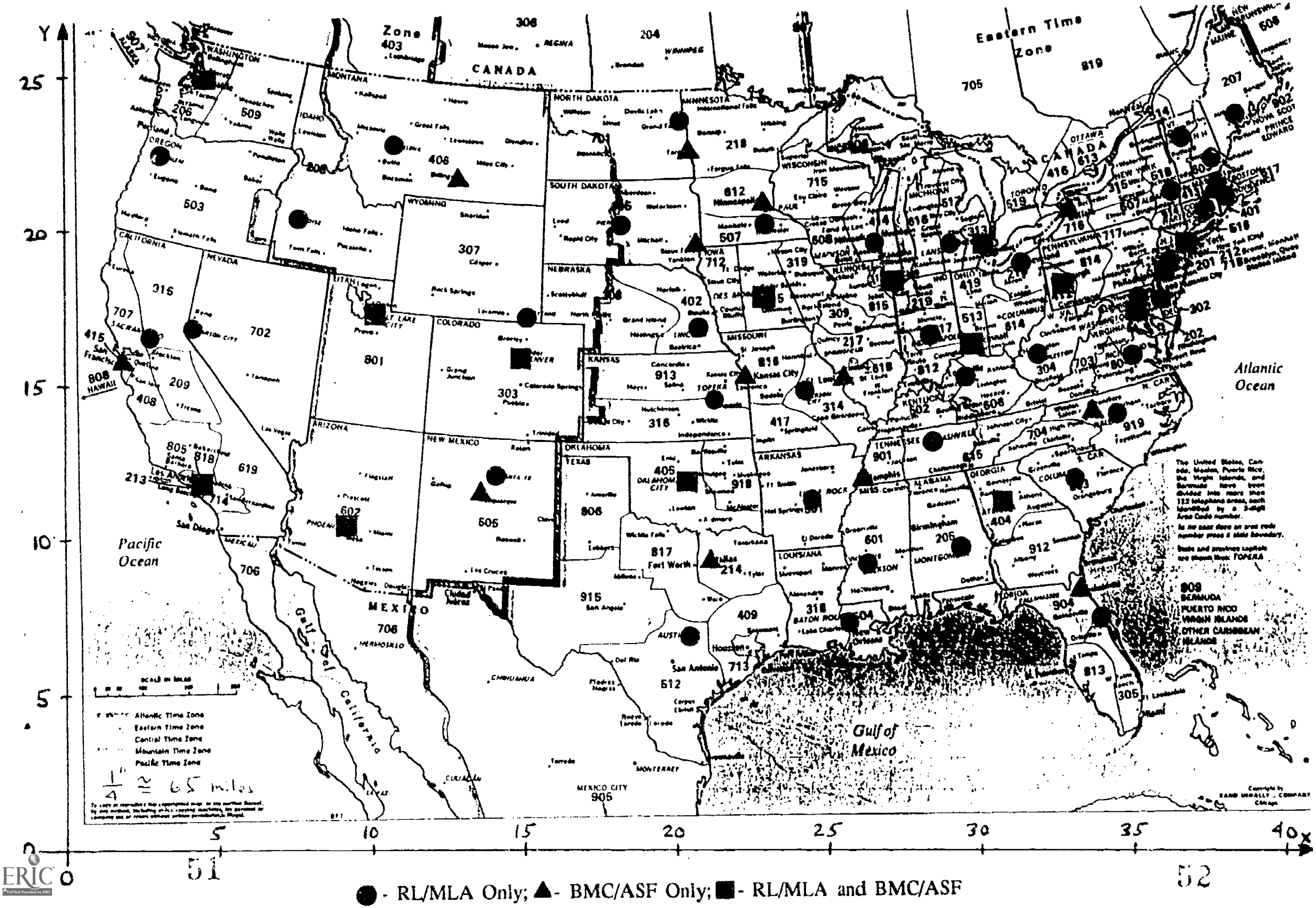
Total: Libraries, Agencies & MSCs

Year	Labor	Occupancy	All Other	Total Cost
Current	$1,461,191	$1,447,726	$417,863	$3,326,781
1	1,527,456	1,513,380	436,814	3,477,650
2	1,596,726	1,582,012	456,623	3,635,362
3	1,669,138	1,653,756	477,331	3,800,225
4	1,744,833	1,728,754	498,978	3,972,565
5	1,823,962	1,807,153	521,606	4,152,721
6	1,906,678	1,889,108	545,261	4,341,047
7	1,993,146	1,974,779	569,989	4,537,914
8	2,083,535	2,064,335	595,838	4,743,708
9	2,178,024	2,157,952	622,859	4,958,835
10	2,276,797	2,255,816	651,106	5,183,718
11	2,380,050	2,358,117	680,634	5,418,800
12	2,487,985	2,465,057	711,500	5,664,543
13	2,600,815	2,576,848	743,767	5,921,430
14	2,718,762	2,693,708	777,497	6,189,966
15	2,842,058	2,815,867	812,756	6,470,681
Total Cost	$33,291,157	$32,984,368	$9,520,422	$75,795,946

Appendix 3

BEST COPY AVAILABLE

NETWORK PROFILE MAP



● - RL/MLA Only; ▲ - BMC/ASF Only; ■ - RL/MLA and BMC/ASF

Appendix 4

NETWORK DEMAND PROFILE

STATE	CITY	X	Y	TOTAL BRAILLE READERSHIP
ALABAMA	MONTGOMERY	29.3	9.7	250
ARIZONA	PHOENIX	9.1	10.3	100
ARKANSAS	LITTLE ROCK	24.5	11.3	160
CALIFORNIA	LOS ANGELES	4.3	11.8	810
CALIFORNIA	SACRAMENTO	2.7	16.6	700
COLORADO	DENVER	14.8	15.9	170
CONNECTICUT	HARTFORD	37.5	20.8	260
DELAWARE	DOVER	36.0	17.8	46
FLORIDA	DAYTONA BEACH	34.0	7.5	840
GEORGIA	ATLANTA	30.7	11.2	800
IDAHO	BOISE	7.7	20.4	48
ILLINOIS	CHICAGO	27.0	18.4	640
INDIANA	INDIANAPOLIS	28.3	16.7	420
IOWA	DES MOINES	22.8	17.8	230
KANSAS	EMPORIA	21.3	14.6	73
KENTUCKY	FRANKFORT	29.6	15.3	160
LOUISIANA	BATON ROUGE	25.7	7.4	410
MAINE	AUGUSTA	38.4	23.8	50
MARYLAND	BALTIMORE	35.2	17.9	150
MASSACHUSETTS	WATERTOWN	37.8	21.6	730
MICHIGAN	LANSING (1)	29.1	19.7	1,043
MICHIGAN	WAYNE (1)	30.0	19.6	347
MINNESOTA	FARIBAULT	23.0	20.3	460
MISSISSIPPI	JACKSON	26.3	9.2	78
MISSOURI	JEFFERSON CITY	24.2	14.8	520
MONTANA	HELENA	10.8	22.8	20
NEBRASKA	LINCOLN	20.7	16.9	120
NEVADA	CARSON CITY	4.2	16.8	24
NEW HAMPSHIRE	CONCORD	37.7	22.4	44
NEW JERSEY	TRENTON	36.4	19.1	320
NEW MEXICO	SANTA FE	14.1	12.1	74
NEW YORK	ALBANY	36.4	21.3	1,090
NEW YORK	NEW YORK CITY	36.8	19.7	1,180
NORTH CAROLINA	RALEIGH	34.6	14.1	450
NORTH DAKOTA	GRAND FORKS (2)	20.2	23.6	18
OHIO	CINCINNATI	29.7	16.3	270
OHIO	CLEVELAND	31.3	19.0	530
OKLAHOMA	OKLAHOMA CITY	20.3	11.8	160
OREGON	SALEM	3.1	22.5	190
PENNSYLVANIA	PHILADELPHIA (3)	36.1	18.8	760
PENNSYLVANIA	PITTSBURGH (3)	32.7	18.3	380

Appendix 4

NETWORK DEMAND PROFILE
(Continued)

STATE	CITY	X	Y	TOTAL BRAILLE READERSHIP
RHODE ISLAND	PROVIDENCE	38.1	21.1	30
SOUTH CAROLINA	COLUMBIA	33.1	12.0	74
SOUTH DAKOTA	PIERRE (2)	18.2	20.3	36
TENNESSEE	NASHVILLE	28.4	13.2	200
TEXAS	AUSTIN	20.4	6.8	1,870
UTAH	SALT LAKE CITY	10.1	17.3	200
VERMONT	MONTPILIER	36.7	23.1	34
VIRGINIA	RICHMOND	35.0	16.0	300
WASHINGTON	SEATTLE	4.6	24.8	370
WASHINGTON DC	WASHINGTON DC	35.1	17.4	70
WEST VIRGINIA	CHARLESTON	31.9	16.0	160
WISCONSIN	MILWAUKEE	26.6	19.7	384
WYOMING	CHEYENNE	15.1	17.2	28
TOTAL READERSHIP,CONTINENTAL UNITED STATES				18,881
ALASKA	ANCHORAGE			28
HAWAII	HONOLULU			70
PUERTO RICO	SAN JUAN			150
VIRGIN ISLANDS	ST. CROIX			(4)
TOTAL READERSHIP, GEOGRAPHIC OUTLIERS				248
TOTAL READERSHIP, UNITED STATES				19,129

(1) - LANSING ASSUMED TO HAVE 75% OF BRAILLE READERSHIP, WAYNE 25%.
(2) - SOUTH DAKOTA ASSUMED TO HAVE 67% OF COMBINED BRAILLE READERSHIP, NORTH DAKOTA 33% .
(3) - PHILADELPHIA ASSUMED TO HAVE 67% OF BRAILLE READERSHIP, PITTSBURGH 33%.
(4) - NO BRAILLE READERSHIP REPORTED.

Appendix 5

NETWORK OF UNITED STATES POSTAL SERVICE BULK MAIL FACILITIES

NO.	CITY	STATE	X	Y	FACILITY TYPE (1)
1	PHOENIX	ARIZONA	9.1	10.3	ASF
2	LOS ANGELES	CALIFORNIA	4.3	11.8	BMC
3	SAN FRANCISCO	CALIFORNIA	1.9	15.8	BMC
4	DENVER	COLORADO	14.8	15.9	BMC
5	WASHINGTON	D.C.	35.1	17.4	BMC
6	JACKSONVILLE	FLORIDA	33.3	8.4	BMC
7	ATLANTA	GEORGIA	30.7	11.2	BMC
8	CHICAGO	ILLINOIS	27.0	18.4	BMC
9	DES MOINES	IOWA	22.8	17.8	BMC
10	KANSAS CITY	KANSAS	22.3	15.3	BMC
11	SPRINGFIELD	MASSACHUSETTS	37.6	21.2	BMC
12	DETROIT	MICHIGAN	30.0	19.6	BMC
13	MINNEAPOLIS	MINNESOTA	23.0	21.0	BMC
14	ST.LOUIS	MISSOURI	25.5	15.2	BMC
15	BILLINGS	MONTANA	12.8	21.7	ASF
16	JERSEY CITY	NEW JERSEY	36.8	19.7	BMC
17	ALBUQUERQUE	NEW MEXICO	13.6	11.6	ASF
18	BUFFALO	NEW YORK	32.9	20.7	ASF
19	GREENSBORO	NORTH CAROLINA	33.7	14.2	BMC
20	FARGO	NORTH DAKOTA	20.5	22.6	ASF
21	CINCINNATI	OHIO	29.7	16.3	BMC
22	OKLAHOMA CITY	OKLAHOMA	20.3	11.8	ASF
23	PHILADELPHIA	PENNSYLVANIA	36.1	18.8	BMC
24	PITTSBURGH	PENNSYLVANIA	32.7	18.3	BMC
25	SIOUX FALLS	SOUTH DAKOTA	20.7	19.6	ASF
26	MEMPHIS	TENNESSEE	26.1	11.9	BMC
27	DALLAS	TEXAS	21.1	9.3	BMC
28	SALT LAKE CITY	UTAH	10.1	17.3	ASF
29	SEATTLE	WASHINGTON	4.6	24.8	BMC

(1) BMC - BULK MAIL CENTER
ASF - AUXILIARY SERVICE FACILITY

Appendix 6

UNITED STATES POSTAL SERVICE
SERVICE STANDARDS
(ZIP CODED MAIL ONLY)

EFFECTIVE 5/15/85

	OVERNIGHT	OVERNIGHT REQUIREMENTS	2nd DAY	3rd DAY	4th DAY	5th DAY	6th DAY	7th DAY	8th DAY	9th DAY	10th DAY
EXPRESS MAIL NEXT DAY SERVICE	OVERNIGHT NATIONWIDE[1]		(SEE DIRECTORY)								
FIRST CLASS	LOCALLY DESIGNATED CITIES AND SCF's	UP TO AND INCLUDING 5:00 P.M. COLLECTIONS	LOCALLY DESIGNATED STATES	REMAINING OUTLYING AREAS							
PRIORITY MAIL	DESIGNATED CITIES	STATED AT MAILING POST OFFICE	NATIONWIDE								
SURFACE PREFER-ENTIAL*	UP TO 150 MILES	5:00 P.M. MAILINGS	300 MILES ____ Zone 3	600 MILES ____ Zone 4	1,000 MILES ____ Zone 5	1,400 MILES ____ Zone 6	1,800 MILES ____ Zone 7	OVER 1,800 MILES ____ Zone 8			
BULK BUSINESS MAIL	AS DEVELOPED LOCALLY	____	INTRA-SCF (for 5:00 P.M. CARRIER PRESORTED MAILINGS)	DESIGNATED SCF's AND NON-PRESORTED INTRA-SCF	UP TO 150 MILES ____ Zone 2	300 MILES ____ Zone 3	600 MILES ____ Zone 4	1,000 MILES ____ Zone 5	1,400 MILES ____ Zone 6	1,800 MILES ____ Zone 7	OVER 1,800 MILES ____ Zone 8
PARCEL POST	SEE SEPARATE STANDARDS ISSUED FOR EACH BULK MAIL CENTER. This form is available at local Post Office.										

*Includes 2nd class, special handling parcel post and special delivery.

SERVICE STANDARDS

Appendix 7

DELIVERY TIME ESTIMATION EQUATION

ACTUAL DAYS	ACTUAL MILES	ESTIMATED DAYS
2	0	3.29
4	150	3.81
5	300	4.32
6	600	5.34
7	1000	6.71
8	1400	8.08
9	1800	9.45

Regression Output:

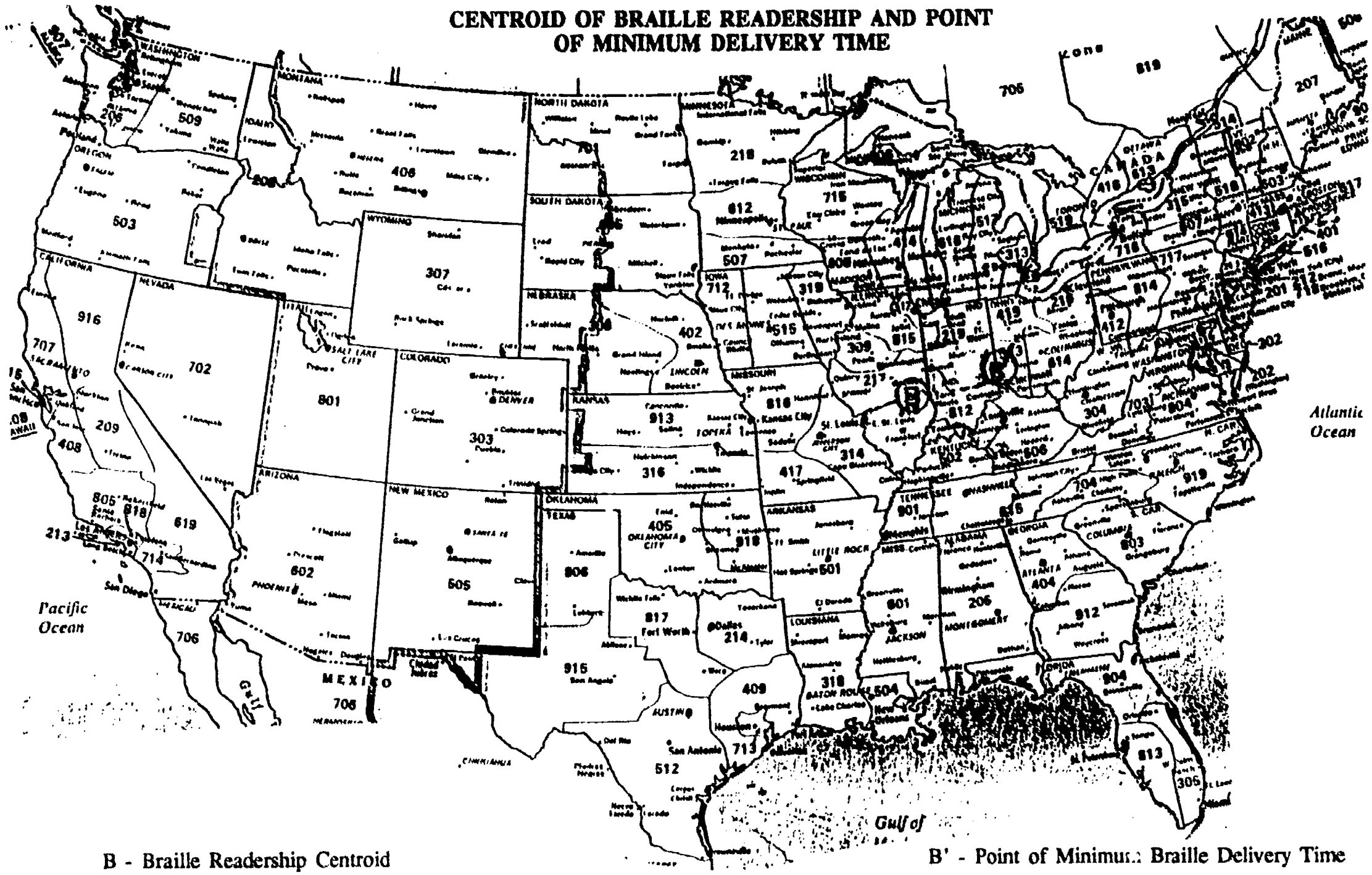
Constant	3.293157
Std Err of Y Est	0.760630
R Squared	0.917010
No. of Observations	7
Degrees of Freedom	5
X Coefficient(s)	0.003418
Std Err of Coef.	0.000459

Regression Equation:

Y = 3.293157 + 0.003418 X
Where Y = Delivery Days
and X = Miles From Origin BMC/ASF

Appendix 8

CENTROID OF BRAILLE READERSHIP AND POINT OF MINIMUM DELIVERY TIME



B - Braille Readership Centroid

B' - Point of Minimum Braille Delivery Time

Appendix 9

LOCATIONS AND DELIVERY TIMES FOR 1-CENTER OPERATIONS

Description	City	State	X	Y	Average Delivery Days	Maximum Delivery Days
Braille Readership Centroid	South-Central	Illinois	26.7	15.9	6.2	10.4
Minimum Delivery Time, Braille	South-East	Indiana	29.1	16.7	6.1	11.0
Postal Bulk Mail Facility	Cincinnati	Ohio	29.7	16.3	6.1	11.2
Postal Bulk Mail Facility	St. Louis	Missouri	25.5	15.2	6.2	10.1
Postal Bulk Mail Facility	Chicago	Illinois	27.0	18.4	6.2	10.4
Postal Bulk Mail Facility	Detroit	Michigan	30.0	19.6	6.2	11.3
Postal Bulk Mail Facility	Pittsburgh	Pennsylvania	32.7	18.3	6.2	12.0
Postal Bulk Mail Facility	Greensboro	N. Carolina	33.7	14.2	6.4	12.5
Postal Bulk Mail Facility	Atlanta	Georgia	30.7	11.2	6.5	12.0
Postal Bulk Mail Facility	Memphis	Tennessee	26.1	11.9	6.4	10.6
Postal Bulk Mail Facility	Kansas City	Kansas	22.3	15.3	6.6	9.2
Postal Bulk Mail Facility	Des Moines	Iowa	22.8	17.8	6.6	9.2
Postal Bulk Mail Facility	Seattle	Washington	4.6	24.8	10.6	13.2
Postal Bulk Mail Facility	Jacksonville	Florida	33.3	8.4	7.1	13.0

Appendix 10

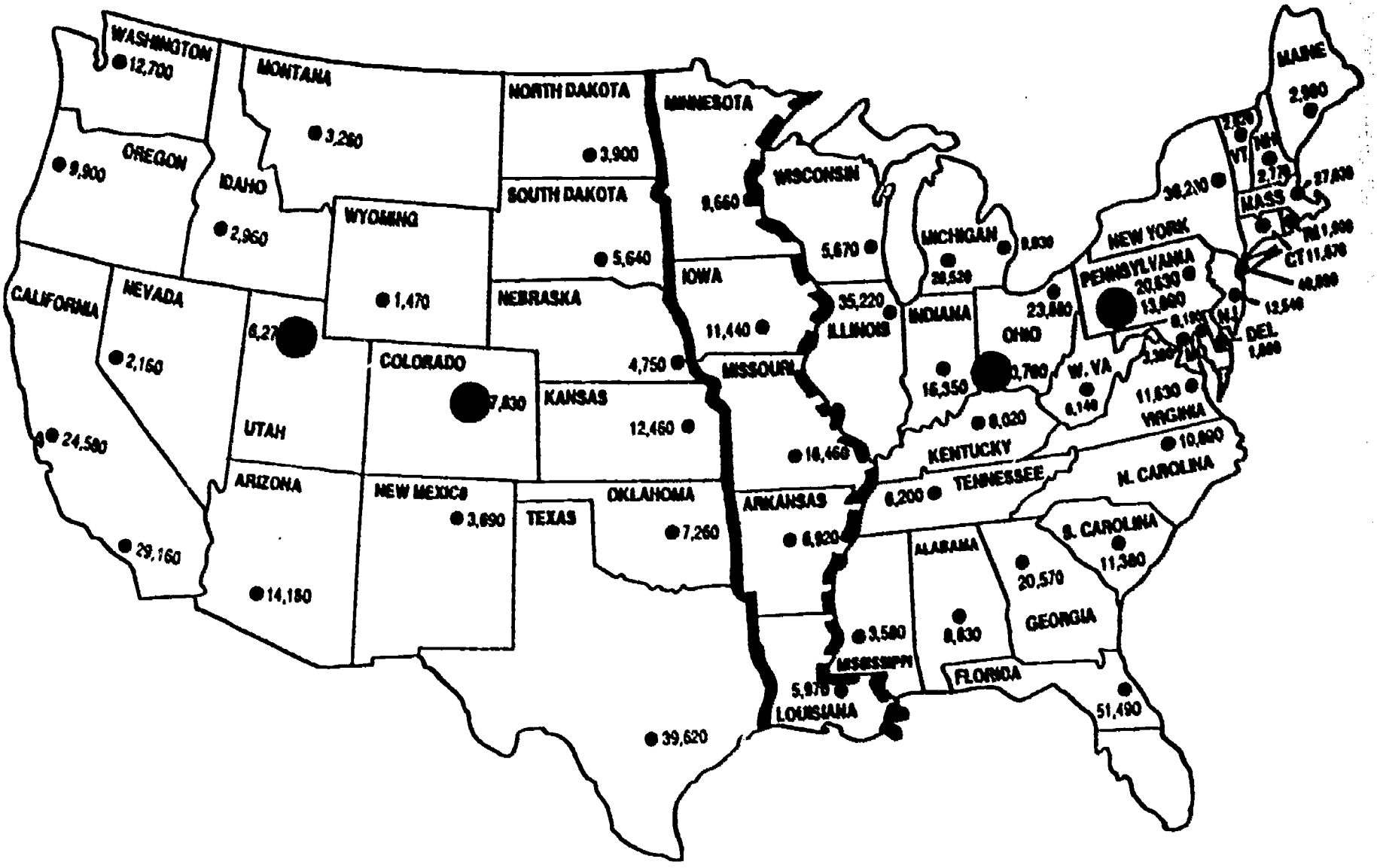
LOCATIONS AND DELIVERY TIMES FOR 2-CENTER OPERATIONS

Location of Centers	Average Delivery Days	Readership (West)	Percent of Readership (West)	Average Delivery Days (West)	Maximum Delivery Days (West)	Readership (East)	Percent of Readership (East)	Average Delivery Days (East)	Maximum Delivery Days (East)
Salt Lake City*/Cincinnati	5.6	6,791	36.0%	6.6	8.7	12,090	64.0%	5.0	6.6
Salt Lake City/Cincinnati*	5.4	5,011	26.5%	6.3	7.6	13,870	73.5%	5.1	6.6
Salt Lake City*/Pittsburgh	5.4	6,791	36.0%	6.6	8.7	12,090	64.0%	4.8	6.5
Salt Lake City/Pittsburgh*	5.3	5,011	26.5%	6.3	7.6	13,870	73.5%	5.0	7.1
Denver*/Cincinnati	5.5	6,791	36.0%	6.3	7.3	12,090	64.0%	5.0	6.6
Denver/Cincinnati*	5.4	5,011	26.5%	6.2	7.2	13,870	73.5%	5.1	6.6
Denver*/Pittsburgh	5.3	6,791	36.0%	6.3	7.3	12,090	64.0%	4.8	6.5
Denver/Pittsburgh*	5.3	5,011	26.5%	6.2	7.2	13,870	73.5%	5.0	7.1
Denver/Washington DC**	5.5	8,923	47.3%	6.5	7.9	9,958	52.7%	4.6	6.2

*-Center that services Minnesota, Iowa, Missouri, Arkansas and Louisiana.
**-Equal Workload Scenario.

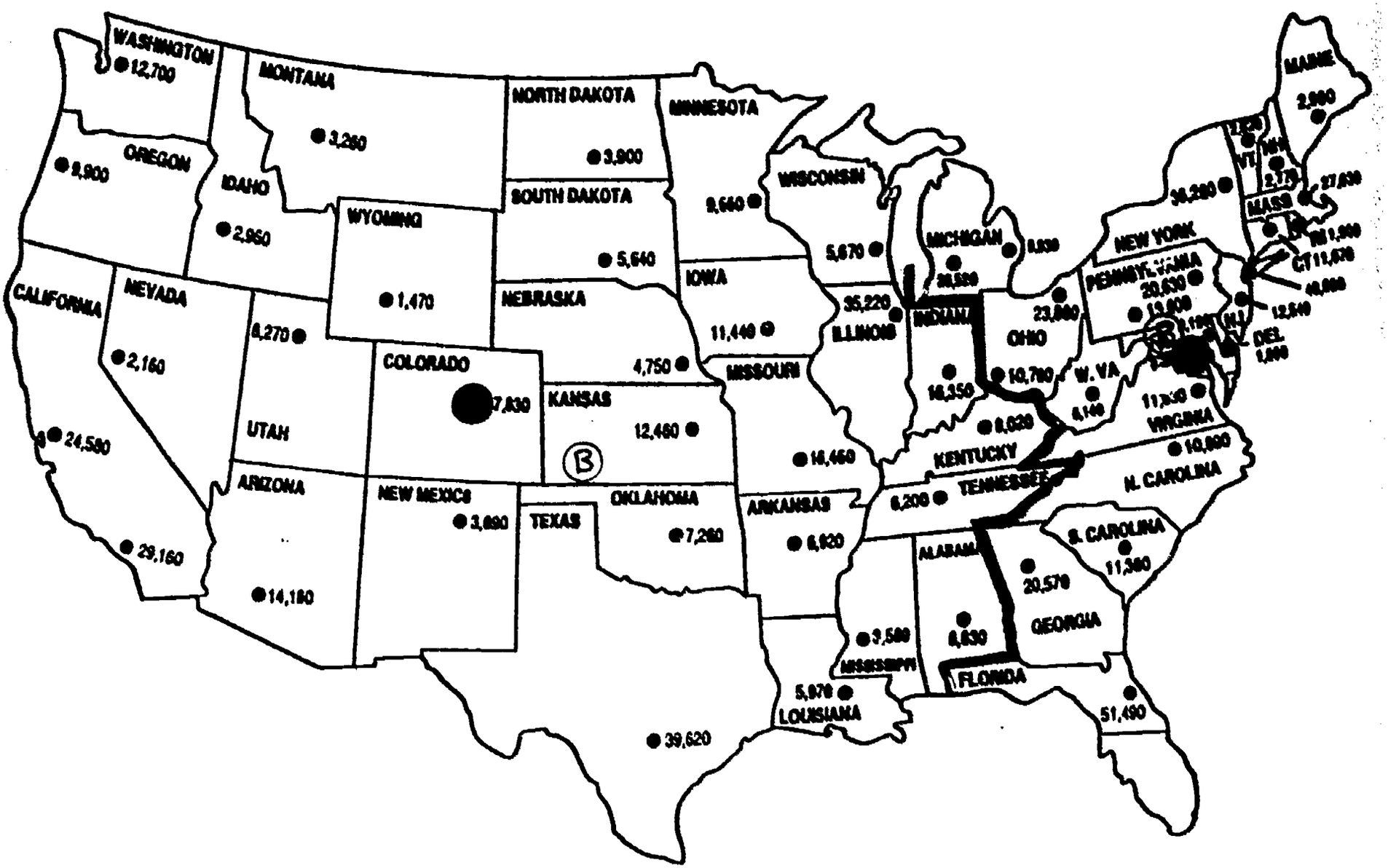
Appendix 11

TWO CENTRAL DISTRIBUTION CENTERS
MINIMUM DELIVERY TIME SCENARIOS



Appendix 12

TWO CENTRAL DISTRIBUTION CENTERS
EQUAL WORKLOAD SCENARIO



B - Braille Readership Centroid

Appendix 13

TWO CENTER SCENARIO
EQUAL WORKLOAD

Region	Operation	City	Readership	%	Average Delivery Days	Maximum Delivery Days
West	Braille	Centroid	8,923	47.3	6.2	8.4
West	Braille	Salt Lake City, UT	8,923	47.3	7.1	9.3
West	Braille	Denver, CO	8,923	47.3	6.5	7.9
West	Braille	Albuquerque, NM	8,923	47.3	6.6	8.1
West	Braille	Oklahoma City, OK	8,923	47.3	6.1	9.2
West	Braille	Kansas City, KS	8,923	47.3	6.1	9.2
West	Braille	Des Moines, IA	8,923	47.3	6.3	9.2
East	Braille	Centroid	9,958	52.7	4.6	6.2
East	Braille	Cincinnati, OH	9,958	52.7	5.1	6.6
East	Braille	Pittsburgh, PA	9,958	52.7	4.7	6.5
East	Braille	Washington, DC	9,958	52.7	4.6	6.2
East	Braille	Greensboro, NC	9,958	52.7	5.0	6.4
East	Braille	Philadelphia, PA	9,958	52.7	4.6	6.6

Appendix 14

AVERAGE ANNUAL PAY BY SELECTED METROPOLITAN AREAS(1)

CITY/STATE	AVERAGE ANNUAL PAY (1987)	PERCENT OF AVERAGE
DES MOINES, IA	N/A(2)	N/A
BILLINGS, MT	N/A	N/A
FARGO, ND	N/A	N/A
ALBUQUERQUE, NM	N/A	N/A
SIOUX FALLS, SD	N/A	N/A
SALT LAKE, UT	$18,856	85.5%
JACKSONVILLE, FL	$19,141	86.8%
GREENSBORO, NC	$19,150	86.9%
BUFFALO, NY	$19,404	88.0%
OKLAHOMA CITY, OK	$19,534	88.6%
MEMPHIS, TN	$19,709	89.4%
PHOENIX, AZ	$20,612	93.5%
KANSAS CITY, MO	$20,848	94.6%
PITTSBURGH, PA	$20,949	95.0%
CINCINNATI, OH	$21,142	95.9%
ST LOUIS, MO	$21,793	98.9%
SEATTLE, WA	$21,863	99.2%
MINNEAPOLIS, MN	$22,385	101.5%
ATLANTA, GA	$22,426	101.7%
PHILADELPHIA, PA	$22,530	102.2%
DENVER, CO	$22,649	102.7%
DALLAS, TX	$22,768	103.3%
CHICAGO, IL	$23,481	106.5%
LOS ANGELES, CA	$23,921	108.5%
SPRINGFIELD, MA(3)	$24,151	109.6%
DETROIT, MI	$25,178	114.2%
WASHINGTON, DC	$25,210	114.4%
SAN FRANCISCO, CA	$25,375	115.1%
JERSEY CITY, NJ	$25,976	117.8%
Average of 24 Known Areas	$22,044	100.0%

(1) - SOURCE, U.S. BUREAU OF LABOR STATISTICS.
(2) - NOT AVAILABLE.
(3) - DATA FOR HARTFORD, CT METROPOLITAN AREA.

Appendix 15

PREVAILING RATES FOR WAREHOUSE SPACE IN SELECTED CITIES AS OF JULY 1, 1990(1)

STATE	CITY	AVERAGE RATE	PERCENT OF AVERAGE
CA	LOS ANGELES	$10.45	196.3
AZ	PHOENIX	$8.28	155.6
FL	JACKSONVILLE	$8.12	152.6
NJ	JERSEY CITY	$6.69	125.7
DC	WASHINGTON	$6.41	120.4
PA	PITTSBURGH	$6.17	115.9
WA	SEATTLE	$6.06	113.9
NC	GREENSBORO	$6.03	113.3
GA	ATLANTA	$5.65	106.2
SD	SIOUX FALLS	$5.57	104.7
PA	PHILADELPHIA	$5.50	103.3
NM	ALBUQUERQUE	$5.11	96.0
TN	MEMPHIS	$4.96	93.2
IA	DES MOINES	$4.95	93.0
IL	CHICAGO	$4.73	88.9
MT	BILLINGS	$4.46	83.8
CO	DENVER	$4.41	82.9
MI	DETROIT	$3.98	74.8
OH	CINCINNATI	$3.97	74.6
MO	ST LOUIS	$3.89	73.1
OK	OKLAHOMA CITY	$3.71	69.7
UT	SALT LAKE CITY	$3.46	65.0
TX	DALLAS	$2.97	55.8
KS	KANSAS CITY	$2.21	41.5
MA	SPRINGFIELD	N/A(2)	N/A(2)
CA	SAN FRANCISCO	N/A(2)	N/A(2)
MN	MINNEAPOLIS	N/A(2)	N/A(2)
ND	FARGO	N/A(2)	N/A(2)
NY	BUFFALO	N/A(2)	N/A(2)
AVERAGE RATE FOR 24 KNOWN CITIES		$5.32	100.0%

(1) - SOURCE, U.S. GENERAL SERVICES ADMINISTRATION.
(2) - NOT AVAILABLE.

Appendix 16
BR NATIONAL COLLECTION STATISTICS
PRODUCED, ACCOUNTED-FOR, AND TARGET LEVELS UNDER CENTRALIZATION

COLUMN 1 BRAILLE TITLE RANGE	COLUMN 2 NUMBER OF TITLES PRODUCED	COLUMN 3 AVERAGE NUMBER OF COPIES PER TITLE	COLUMN 4 NUMBER OF COPIES PRODUCED	COLUMN 5 AVERAGE NUMBER OF VOLUMES PER COPY	COLUMN 6 NUMBER OF VOLUMES PRODUCED	COLUMN 7 TARGET NUMBER OF COPIES PER TITLE	COLUMN 8 NATIONAL TARGET NUMBER OF COPIES	COLUMN 9 NATIONAL TARGET NUMBER OF VOLUMES
1 - 999	960	60	57,600	3	172,800	10	9,600	28,800
1000-1999	993	60	59,580	3	178,740	10	9,930	29,790
2000-2999	993	60	59,580	3	178,740	10	9,930	29,790
3000-3999	890	60	53,400	3	160,200	20	17,800	53,400
4000-4999	990	60	59,400	3	178,200	40	39,600	118,800
5000-5999	998	60	59,880	3	179,640	40	39,920	119,760
6000-6999	996	60	59,760	3	179,280	60	59,760	179,280
7000-7999	840	60	50,400	3	151,200	60	50,400	151,200
8000-8999	6	60	360	3	1,080	60	360	1,080
TOTAL	7,666		459,960		1,379,880		237,300	711,900
VOLUMES ACCOUNTED FOR IN LIBRARIES								814,617
VOLUMES ACCOUNTED FOR IN MSCs								91,992
TOTAL VOLUMES ACCOUNTED FOR								906,609
TOTAL VOLUMES DISPOSED OF OR UNACCOUNTED FOR								473,272

Appendix 17
CURRENT BRA AND SPECIAL COLLECTIONS STORED IN MSCs

LINEAR FEET OF SHELVING USED

COLLECTION	MSCM/S	MSCN	MSCW	TOTAL
BRA	6,336	6,210	6,984	19,530
BRF	2,112	0	0	2,112
BRA RESERVES	0	0	3,760	3,760
BRA MASTERS	0	0	6,328	6,328
BRA PRE 13000	0	0	13,480	13,480
BRJ	0	0	3,600	3,600
TOTAL	8,448	6,210	34,152	48,810

AVERAGE VOLUMES PER LINEAR FOOT

COLLECTION	MSCM/S	MSCN	MSCW	AVERAGE
BRA	7.5	6	5	6.2
BRF	6	---	---	6.0
BRA RESERVES	---	---	4.7	4.7
BRA MASTERS	---	---	4.7	4.7
BRA PRE 13000	---	---	4.7	4.7
BRJ	---	---	4.7	4.7

COLLECTION SIZE IN VOLUMES

COLLECTION	MSCM/S	MSCN	MSCW	TOTAL
BRA	47,520	37,260	34,920	119,700
BRF	12,672	0	0	12,672
BRA RESERVES	0	0	17,559	17,559
BRA MASTERS	0	0	29,552	29,552
BRA PRE 13000	0	0	62,952	62,952
BRJ	0	0	16,812	16,812
TOTAL	60,192	37,260	161,795	259,247

Appendix 18
PROPOSED APPORTIONMENT OF NATIONAL BRAILLE COLLECTION

COLLECTION	WESTERN CENTER (VOLUMES)	EASTERN CENTER (VOLUMES)	TOTAL (VOLUMES)
BR REGULAR	284,760	427,140	711,900
BRA REGULAR	39,900	79,799	119,699
BRF	12,672	0	12,672
BRA RESERVES	17,559	0	17,559
BRA MASTERS	29,552	0	29,552
BRA PRE-13,000	62,952	0	62,952
BRJ	16,812	0	16,812
TOTAL VOLUMES	464,207	506,939	971,146
PERCENT OF TOTAL	48%	52%	100%

Appendix 19
AVERAGE LABOR COST PER READER AND READERSHIP
16 REGIONAL BRAILLE LIBRARIES IN SAMPLE

SORTED ON LABOR COST PER READER		SORTED ON READERSHIP	
BRAILLE READERSHIP	LABOR COST PER READER	BRAILLE READERSHIP	LABOR COST PER READER
260	$235.57	70	$174.78
160	$222.54	150	$176.81
150	$176.81	160	$222.54
70	$174.78	260	$235.57
270	$118.59	270	$118.59
1,346	$116.96	370	$70.24
370	$70.24	410	$55.16
840	$62.46	520	$35.33
910	$55.94	700	$41.04
410	$55.16	766	$47.50
766	$47.50	800	$21.27
700	$41.04	840	$62.46
1,870	$38.77	910	$55.94
520	$35.33	1,346	$116.96
800	$21.27	1,390	$20.04
1,390	$20.04	1,870	$38.77

	LABOR COST PER READER
UNWEIGHTED MEAN, 16 SITES	$93.31
WEIGHTED MEAN, 16 SITES	$62.58
MEDIAN, 16 SITES	$59.20
UNWEIGHTED MEAN, 11 SITES WITH READERSHIP > 300	$51.34
MEDIAN, 11 SITES WITH READERSHIP > 300	$47.50

Appendix 20

ESTIMATED LABOR COSTS FOR BRAILLE OPERATIONS
CENTRAL DISTRIBUTION AND CURRENT COSTS
COST PER READER BASIS

	Labor Cost, Regular Collections	Labor Cost Per Reader	Labor Cost, Special Collections	Total Labor Cost	Total Labor Cost Per Reader
Current Costs	$1,372,149	$71.73	$89,043	$1,461,192	$76.38
Central Distribution					
Mean of 11 Sites > 300 Readers	$982,083	$51.34	$89,043	$1,071,126	$55.99
Median of 11 Sites > 300 Readers	$908,628	$47.50	$89,043	$997,671	$52.15
Mean of 16 Sites	$1,197,093	$62.58	$89,043	$1,286,136	$67.23
Median of 16 Sites	$1,132,437	$59.20	$89,043	$1,221,480	$63.85

Appendix 21
FACILITY SPACE UTILIZATION IN BRAILLE LIBRARIES

BRAILLE COLLECTION (VOLUMES)	AREA (SF) USED FOR STORAGE	STORAGE DENSITY (VOL/SF)	AREA (SF) USED FOR NON-STORAGE	TOTAL AREA (SF)	STORAGE AREA PERCENT OF TOTAL	NON-STORAGE AREA PERCENT OF TOTAL
35,200	4,021	8.8	3,896	7,917	51%	49%
50,579	6,791	7.4	2,247	9,038	75%	25%
17,700	2,197	8.1	954	3,151	70%	30%
10,000	1,040	9.6	587	1,627	64%	36%
11,250	1,376	8.2	453	1,829	75%	25%
17,889	2,028	8.8	733	2,761	73%	27%
19,000	2,262	8.4	550	2,812	80%	20%
10,379	1,174	8.8	318	1,492	79%	21%
62,500	6,579	9.5	2,399	8,978	73%	27%
43,000	5,556	7.7	388	5,944	93%	7%
19,250	2,194	8.8	458	2,652	83%	17%
45,865	3,872	11.8	1,267	5,139	75%	25%
22,900	2,139	10.7	367	2,506	85%	15%
16,126	1,175	13.7	278	1,453	81%	19%
20,714	1,483	14.0	353	1,836	81%	19%
76,860	6,216	12.4	373	6,589	94%	6%
479,212	50,103		15,621	65,724		
	WEIGHTED	9.6		WEIGHTED	76%	24%
	UNWEIGHTED	9.8		UNWEIGHTED	77%	23%

Appendix 22

FACILITY SPACE UTILIZATION
MULTISTATE CENTERS

LINEAR FEET OF SHELVING USED

COLLECTION	MSCM/S	MSCN	MSCW	TOTAL
BR	5,520	5,148	10,080	20,748
BRA	6,336	6,210	6,984	19,530
BRF	2,112	0	0	2,112
BRA RESERVES	0	0	3,760	3,760
BRA MASTERS	0	0	6,328	6,328
BRA PRE 13000	0	0	13,480	13,480
BRJ	0	0	3,600	3,600
TOTAL	13,968	11,358	44,232	69,558
BR TOTAL	5,520	5,148	10,080	20,748
NON-BR TOTAL	8,448	6,210	34,152	48,810

LINEAR FEET OF SHELVING UNUSED

COLLECTION	MSCM/S	MSCN	MSCW	TOTAL
BR	1,296	684	6,288	8,268
BRA	864	0	5,184	6,048
BRF	208	0	0	208
BRA RESERVES	0	0	0	0
BRA MASTERS	720	0	0	720
BRA PRE 13000	0	0	0	0
BRJ	0	0	0	0
TOTAL	2,368	684	12,192	15,244
BR TOTAL	1,296	684	6,288	8,268
NON-BR TOTAL	1,072	0	5,904	6,976

VACANCY RATIO

BR TOTAL	0.23	0.13	0.62	0.40
NON-BR TOTAL	0.13	0.00	0.17	0.14

Appendix 22

FACILITY SPACE UTILIZATION
MULTISTATE CENTERS
(Continued)

COLLECTION SIZE IN VOLUMES

COLLECTION	MSCM/S	MSCN	MSCW	TOTAL
BR	22,998	22,998	45,996	91,992
BRA	47,520	37,260	34,920	119,700
BRF	12,672	0	0	12,672
BRA RESERVES	0	0	17,559	17,559
BRA MASTERS	0	0	29,552	29,552
BRA PRE 13000	0	0	62,952	62,952
BRJ	0	0	16,812	16,812
TOTAL	83,190	60,258	207,791	351,239
BR TOTAL	22,998	22,998	45,996	91,992
NON-BR TOTAL	60,192	37,260	161,795	259,247

SPACE UTILIZATION (SF)

BR TOTAL	972	1,551	2,123	4,646
NON-BR TOTAL	1,650	1,403	7,778	10,831

STORAGE DENSITY NOT CONSIDERING VACANT SHELVES (VOL/SF)

BR TOTAL	23.7	14.8	21.7	19.8
NON-BR TOTAL	36.5	26.6	20.8	23.9

STORAGE DENSITY CONSIDERING VACANT SHELVES (VOL/SF)

BR TOTAL	29.2	16.8	35.2	27.7
NON-BR TOTAL	41.1	26.6	24.4	27.4

Appendix 23

ESTIMATED OCCUPANCY REQUIREMENTS AND COSTS BASED ON CURRENT COLLECTION SIZE BRAILLE CENTERS

12-LEVEL, 13' HIGH STORAGE

	Western Center	Eastern Center	Total
Storage Area (sf)	18,560	20,280	38,840
Non-storage Area (sf)	4,600	5,100	9,700
Total Area (sf)	23,160	25,380	48,540
Unit Occupancy Cost	$3.46	$3.97	
Total Estimated Occupancy Cost	**$80,133**	**$100,758**	**$180,891**

7-LEVEL, 8' HIGH STORAGE

Storage Area (sf)	31,800	34,700	66,500
Non-storage Area (sf)	4,600	5,100	9,700
Total Area (sf)	36,400	39,800	76,200
Unit Occupancy Cost	$3.46	$3.97	
Total Estimated Occupancy Cost	**$125,944**	**$158,006**	**$283,950**
Total Current Network Occupancy Costs			**$1,448,000**