EVALUATION AND IMPROVEMENT OF MAIL PREPARATION OPERATIONS AT THE ATLANTA POST OFFICE

FINAL REPORT FOR TASK I
"Evaluation and Improvement of the Mail Preparation Subsystem"
Under USPS Contract 74–02224

Presented to the
United States Postal Service

By the
School of Industrial & Systems Engineering
Georgia Institute of Technology

December 20, 1974
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December 20, 1974
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I. EXECUTIVE SUMMARY

A. INTRODUCTION

1. Identification. This is the final report for Task 1, "Evaluation and Improvement of the Mail Preparation Subsystem," under USPS Contract 74-02224. This task was carried out in three phases. Phase I consisted of observation and description of the Atlanta mail processing system. The results of Phase I were given in the report, "Description of Mail Preparation Operations at the Atlanta Post Office," August 12, 1974. Phase II involved identification and analysis of improvement alternatives for the mail preparation operations at the Atlanta Post Office. The report "Analysis of Mail Preparation Operations at the Atlanta Post Office," October 15, 1974, describes the results of Phase II. Phase III involved discussion of Phase II recommendations with USPS engineers and operations management, additional evaluation of alternatives, and development of implementation plans. In this report the findings, conclusions, and recommendations from all three phases are summarized.

2. Objectives and Scope. The primary purpose of the project was to develop implementable recommendations for improvement in the mail preparation operations of the Atlanta Post Office. The ultimate objective is to increase the productivity of these operations as measured by the number of letters faced and cancelled per man-hour.
The scope of the study included principally the mail preparation operations numbered 010 and 020, although attention was given to certain other operations, particularly collection and dock handling, as they affect or are affected by 010 and 020. The study was conducted entirely at the Atlanta Post Office.

A secondary objective was to indoctrinate the Georgia Tech study team in the methods and procedures used to process collection mail in anticipation of follow-on tasks involving detailed studies of collection operations.

3. Approach. The study team consisted of five Georgia Tech faculty and a number of graduate research assistants. Information was gathered through (1) discussions with Atlanta operating managers and industrial engineers from Atlanta, Memphis, and Washington, (2) review of reports of previous studies of the mail preparation system and statistical records of past 010/020 performance, and (3) actual observation and collection of data, including several controlled experiments. Considerable effort was spent on the latter activities. Based on the information gathered, areas for improvement were identified and specific improvement alternatives were defined. These alternatives were reviewed with engineering personnel from Atlanta, Memphis, and Washington, as well as Atlanta operating management. Based on their reaction and suggestions, certain alternatives were discarded and others were investigated further. Attention was given to the feasibility of implementation of recommendations.
4. **Acknowledgements.** A number of people made positive contributions to assist the study team. Mr. George W. Camp and members of his staff--especially Mr. Ray Power, Mr. Richard Rudez, Mr. Richard Moore, and Mr. Marvin Berkowitz--were most helpful. Also, the team benefitted greatly from assistance provided by Mr. Ralph Siegel and Mr. Sam HeLal from the Washington engineering staff.

5. **Report Organization.** The remainder of the Executive Summary contains a listing of important findings about the present system and a summary of recommendations. There are two other major sections in the report. The first gives a description of the present system, and the second describes conclusions and recommendations.

B. **PRESENT SYSTEM**

1. A substantial percentage of total originating mail appears to come from a small proportion of branches and stations. For a sample study period of eight days, extending from 7/18/74 through 7/26/74, it was found that approximately 40 per cent of total originating mail from branches and stations was contributed by only 18.5 per cent of the branches and stations.

2. There often is substantial disparity in the amount of presorting of originating mail by the various branches and stations. The data collected during the period specified above was broken into categories reflecting the condition of originating mail sent to the Federal Annex from each station. For the given period, it was found that 34.4 per cent of the branches and
stations sent originating input to the Annex that contained at least 25 per cent mixed mail. Mail classified as "mixed" had undergone no segregation or presort at the branches or stations.

3. There is a high variance in the amount of originating mail returned to the Annex per delivery run. It is understood that this is due to existing pick-up and delivery constraints that must be adhered to.

4. The handling of originating mail on the receiving dock at the Federal Annex is such that congestion often occurs and space and labor utilization are low.

5. The mail processing facility at the Federal Annex of the Atlanta Post Office consists of a centralized culling system and 10 facer-canceller machines. There are two parallel rough culling belts feeding a pyramid conveyor system that distributes mail to eight of the facer-cancellers (six Mark II machines and two NCR machines). The remaining two machines, one Mark II and one NCR, are free-standing; however, this Mark II can be supplied with mail from the centralized conveyor system through use of an edger-stacker machine.

6. A detailed description of the single centralized culling and distribution system was prepared and is contained in the Phase I report.

7. Average volume and composition of mail flows at different points in the system were estimated by sampling. Results are contained in the Phase I report, dated 8/12/74.
8. Downtime of the manual culling belts was observed to be as high as 31 per cent for an observation period. This was attributed to overloading of the automatic fine culling machines.

9. Gaps in the mailstream on the manual culling belts were observed to range between 7 and 18 per cent. These are caused by uneven dumping.

10. The percentage of flats, slugs, and SPRs removed by the manual culling ranged from 53 to 57 per cent. This figure increased to 75 per cent when only two cullers were placed at each belt, with a proportional decrease in volume.

11. Of the mail tossed on the flat belt, only 31 per cent is what it should be (stamped flats), the rest being largely bundled letters and metered flats.

12. The mail reaching the vibrator hoppers has the following composition:

<table>
<thead>
<tr>
<th>Composition</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Stamped letter mail</td>
<td>64.9%</td>
</tr>
<tr>
<td>Metered letter mail</td>
<td>27.2%</td>
</tr>
<tr>
<td>Business reply; penalty</td>
<td>4.4%</td>
</tr>
<tr>
<td>No postage</td>
<td>0.5%</td>
</tr>
<tr>
<td>Flats, slugs, bundles</td>
<td>3.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0%</strong></td>
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Approximately 5 per cent of the letter mail is nonmachinable.
Almost 98 per cent of the stamped letter mail and 87 per cent of the metered letter mail were "hot."

13. The thicks and heights extractors on the edger-feeder machines remove approximately 7 and 6 per cent, respectively, of the mail stream. The remaining 87 per cent is fed to the facer-cancellers.
14. Approximately 41 per cent of the mail removed by the thicks extractor is undamaged letter mail less than \( \frac{3}{4} \) inch thick and hence machinable. Several experiments were conducted in an attempt to reduce these errors. Reversing the helix of the gauge roller produced a larger error rate and therefore is not considered a solution to the problem. Raising the gauge roller to a height of 7/16 inch reduced the total volume removed by a factor of 25, reduced the error rate to 10 per cent, and did not cause an increase in jamming of the facer-canceller. The USPS staff, however, feels that with any setting greater than \( \frac{3}{4} \) inch, there is a serious risk of passing mail sufficiently thick to cause breakdowns of facer-canceller or LSM machines. During a three-hour experiment conducted by the study team, no problems were observed with the facer-canceller.

15. Because of improper edging of the mail, approximately 45 per cent of the volume removed by the heights extractor is machinable mail.

16. The average throughput of a Mark II machine fed by a Model 500 edger-feeder is approximately 17,000 pieces per clock hour. For some machines the throughput is well over 20,000 pieces per hour. During the nonpeak period, because of the lack of availability of mail, this throughput drops to 13,000 pieces per hour. The productivity of an NCR machine during peak and nonpeak hours is respectively 13,000 and 8,000 pieces per hour.

17. For Mark II machines, the frequency of jamming is approximately 25-30 jams per productive hour (that is, when mail is available and the machine is running), with an average jam duration of 0.3 minute.
18. Approximately 92 per cent of A and B stacker contents on Mark II facer-cancelers are faced and cancelled properly. About 7 per cent are misfaced and 1 per cent are not cancelled.
19. Approximately 19 per cent of the mail fed to the Mark II machines goes to the bypass stacker.
20. Approximately 49 per cent of mail in the bypass stacker is hot and represents an error.
21. Production, in terms of pieces fed per hour, from a hand-fed Mark II is about 10-15 per cent greater than from a mechanically-fed machine.

C. RECOMMENDATIONS

1. **Instigation of Branch/Station Presort.** From Phase I analysis, it is obvious that the condition in which originating mail is sent to the Annex is largely the condition in which it is advanced to 010. Hence, it is recommended that branches and station personnel attempt to presort originating mail by categories that reflect, at least, machineability and non-machineability. The specific, individual implementation of such a presort strategy would be dependent upon branch personnel levels, space availability, and the compatibility of pick-up vehicles.

2. **Assign Dock Workers to Fixed Jobs and Where Possible to Fixed Locations.** A prime contributor to dock congestion appears to be the freedom of movement of personnel on the dock and the inherent mixing of work flow patterns that accompany this practice.
3. **The Assignment of Contingency or Backup Jobs on the Dock** Should Be Attempted. Often, workers will allow their effort to be retained by certain tasks to the extent that when heavy work periods arise, their lack of attention and effort relative to other more crucial operations can cause backlogging and hence additional congestion.

4. **An Attempt Should Be Made to Clear By-Pass Mail Sooner.** A large amount of originating mail from the Central Business District (CBD) is unloaded near the dumping belts, an area which is often congested. Further, much of the CBD mail is pretrayed and metered, hence it can by-pass O10. However, in handling such mail and specifically in attempting to consolidate originating volume from several deliveries, increasing congestion in the area creates delays and necessarily more congestion. Hence, it is suggested that by-pass mail be moved out of the area sooner, even at the expense of moving partially loaded hampers.

5. **When possible, an attempt should be made to make a one-to-one exchange of empty for loaded hampers subject to vehicle capacity, handling capability, and hamper availability.**

6. **There should be maintained fixed locations on the dock for as many presort hampers as possible.** In addition, multiple presort hampers which have low utilization should be eliminated.
7. Canvas sacks on hampers should be secured to the base of the hamper. Often, unsecured canvas liners create dumping problems when loose letter mail becomes "wedged" in the liner, creating a delay at the dumpers.

8. In order to aid in congestion reduction and preserve space, empty hampers should be stored inside one another when possible.

9. **Forecast Mail Volumes.** Productivity per man-hour tends to be higher on high-volume days, indicating that a forecasting model would be useful in determining general staffing levels. If successful, the potential savings in direct labor could be about $50,000 per year, versus an estimated first-year cost of less than $3,000. It is recommended that USPS implement a forecasting model for total daily 010, 020 volumes by extending the statistical analysis performed by the study team, included in Section III-B of this report.

10. **Provide In-Process Inventory at Dumping Hoppers.** This would eliminate some of the gaps in the mailstream at the culling belts, allowing for later start times and higher productivity. The negative effect would be to delay some of the mail arrivals at the sorting operation. USPS reaction was favorable to trying this, given the details on mail delays that are included in Section III.

11. **Install Timing Devices and Stiffer Flaps on Dumping Hoppers.** A buzzer interval timer and stiffer flaps would help provide a more uniform flow on the culling belts and eliminate gaps in the
mailstream. USPS requested additional details, which are given in Section III and Appendix A.

12. **Eliminate Movements of Partial Hamper Loads.** This is intended to encourage an attitude of productive efficiency. USPS reaction was favorable. Implementation is by instruction.

13. **Separate the Two Culling Lines.** The east culling line experiences excessive downtime because the reject mail from the west line overloads the automatic fine culling machine. Because of the high cost of changeover and expected short benefit period, this change is not justifiable, and therefore no final recommendation is made.

14. **Change Delay Time on AFC-3 from 4 to 2 Seconds.** Much of the excessive downtime on AFC-3 is attributable to a 4-second delay when overloaded. A change to 2 seconds will result in smoother mail flow on the take-away belt and less downtime on the manual culling belt. USPS reaction was favorable. Implementation consists of adjustment of electrical control elements.

15. **Thin Out the Mailstream on the Culling Belts.** Culling performance is better when fewer workers are stationed on a belt, given the same volume/worker. USPS reaction was favorable. Implementation can be achieved in the late afternoon, when the culling staff is at half its normal manpower level.

16. **Move SPR and Slug Cancelling.** Relocation of SPR and slug cancelling near the 110 operation would eliminate a substantial amount of traffic through, and backtracking through, an aisle bottleneck. USPS requested more details. Appendix B contains a sketch of the proposed layout changes.
17. **Shorten the Reject Belt RE-3.** This item is intended to help clear congestion in the same aisle bottleneck. **USPS** reaction was favorable, provided enough worker positions could be located on the shorter belt.

18. **Combine Stamped and Meter SPR's and Slugs at Manual Culling.**

A slight increase in man-hours at SPR and slug cancelling would be offset by a productivity increase at manual culling. **USPS** reaction was negative, because of delayed mail arrival at the 110 operation. No final recommendation is made.

19. **Use U-Carts at Manual Culling.** Each manual culler could be more effective if he had his own containers, such as U-carts, near his elbows, rather than having to toss items anywhere from 2 to 12 feet away. **USPS** requested more information. Appendix C contains a sketch of the proposed layout.

20. **Separate Faced and Stacked Stamped Letters at Dumping.** This recommendation involves closer supervision to ensure that these items are separated and sent directly to a facer-canceller or portable canceller. **USPS** reaction was favorable.

21. **Eliminate Input at Plexiglass Window at CC-4.** This recommendation is designed to eliminate congestion in a major personnel aisle. **USPS** requested alternatives. The final recommendation is that loose, machineable letters should be entered into the feed hoppers for facer-cancellers 2, 3, and 4.

22. **Provide Tables for Culling Flats Brought in from Dock.** This item arose from aisle congestion near the flat belt. With the
relocation of SPR and slug cancelling, the aisle congestion should decrease. Thus, no final recommendation is made.

23. **Post Task Instructions for Employees.** Worker efficiency can be improved and errors reduced with simple, clear task instructions. USPS requested additional information. Appendix D contains sample lists of such instructions for manual culling, reject belt, flat belt, bundled letters belt, and SPR and slug cancelling.

24. **Recycle Bypass Stacker Contents.** Reprocess the contents of bypass stackers by hand feeding on the free-standing NCR machine (Number 10) or the free-standing Mark II (Number 9), if available. It is expected that this would result in saving 30 to 40 man-hours per day. These savings are realized by the elimination of the cycling of uncanceled stamped letter mail in the bypass stackers through the less efficient 035 and flyer cancellation operations. The USPS reaction to this recommendation is mixed because of the increased load placed on the facer-cancellers by recycling. Also it may be possible to reduce the amount of "hot" bypass mail by improved adjustment and maintenance of the facer-cancellers.

25. **Modify Inclined Conveyor on Edger-Feeder.** Reduce the inclination of the conveyor from its current setting of 40.3° to an inclination of 38.1° and use the maximum belt speed of 45 feet per minute. This results in increasing the potential feed of this conveyor from 27,000 pieces per hour to 33,000 pieces per hour. This is expected to increase the average throughput at the Mark II machine from 17,000 to 20,800 pieces per hour. The USPS reaction
to this recommendation is quite favorable and a limited implementa-
tion is already under way at the Atlanta facility. Additionally
a study comparing the effects of reducing the angle of the
conveyor belt and using a different belt material is being
conducted by the Atlanta Post Office staff.

26. Schedule as Few Facer-Cancellers as Possible. A machine
scheduling procedure is proposed for using the minimal required
number of machines, recycling the contents of the bypass stackers,
and meeting the 9:15 p.m. processing deadline. A savings of
approximately 10 man-hours per day is realized over the present
scheduling system.

27. Attempt to Improve Edging of Feed to Heights Extractor. Consider
installing an additional metal plate, or similar device, prior
to the heights extractor for the purpose of securing a more
effective edging of the mail. It is expected that this device
would reduce the error rate of the heights extractor. It is
recommended that the Atlanta engineering staff experiment with
different locations for the additional plate in order to obtain
the best performance.

28. Improve the Quality of Maintenance Provided the Facer-Canceller
Machines. High error rates on facer-canceller machines, particularly
the amount of "hot" mail in the bypass stackers indicate a need
for improved maintenance. The Atlanta Post Office during early
1974 lost approximately 26 trained maintenance employees to the
new Bulk Mail Facility. During the period of recruitment and
training of replacements, equipment maintenance suffered. It has been impossible at times to provide qualified manpower to carry out the 30 hours per day of preventive maintenance required for the 10 facer-cancellers. Problems of job turnover are caused in part by employees transferring to better paying or otherwise more desirable positions. It might be well to reevaluate the maintenance jobs in question to insure that they are properly related to other jobs.

29. Implement Additional Procedures to Control Performance. In the Phase II report of 10/15/74, it was recommended that effective control procedures be implemented to periodically measure and evaluate performance of the edger-feeder/facer-canceller system. Subsequently, it was learned that the publication "Mechanized Mail Preparation, Fiscal Year 1975, A Guide to Optimum Performance" (Publication 36, November 1974) has been officially adopted as USPS policy. This document contains several procedures, including forms, for sampling, analyzing, and reporting on facer-canceller operating performance. It is recommended that these procedures be implemented, with the additional use of statistical control charts for certain key performance variables. The Atlanta Post Office industrial engineering staff has been studying the adaptation of the procedures to Atlanta's operations, including the use of statistical quality control techniques.
II. DESCRIPTION OF PRESENT SYSTEM

A. GENERAL SYSTEM DESCRIPTION

In this section, a brief overview of the mail preparation system of the Atlanta Post Office is given. More detail is provided in subsequent sections.

The complexion of mail entering the system is varied. Specific mail types are important to recognize and classify since their differences have an important impact on the mail processing operations. Originating mail may be classified broadly into the categories of letters, flats (large, thin envelopes), slugs (thick envelopes), and small parcels and rolls (SPR's). In addition to these categories, which primarily classify mail relative to its physical attributes (size and shape), a further breakdown can be given that categorizes mail according to customer processing attributes such as stamped, airmail, and metered. Also, unit loads in which mail is handled provide for classifications such as bundles, trays, sacks, and hampers. Finally, the degree of customer preparation is of interest and mail can be classified as mixed or presorted to various degrees and faced or unfaced.

Originating mail is brought to the Federal Annex for processing. This mail is obtained from collection boxes, branches and stations, large volume mailers in the central business district, and
associate offices. Much of the letter mail is metered and faced and therefore can bypass the mail preparation process. There also is a large amount of metered and bundled letter mail that can be efficiently processed by operation 020. However, considerable mail arrives in a mixed form, especially mail from the collection boxes via branches and stations. This mail must be separated into appropriate categories by culling operations in order to facilitate facing and cancelling.

Mail brought to the Federal Annex is unloaded onto a receiving dock where it undergoes a minimal cull to separate mail into categories. Most of the mail must then be processed through the mail preparation operations 010 and 020. Primary objectives of these operations are to cancel stamped mail, provide faced mail for subsequent sorting operations, and segregate items such as air mail, flats, slugs, and SPR's for separate processing. The 020 operation handles bundled metered mail, which is easily faced and trayed. The 010 operation consists of manual culling (rough culling) to separate nonmachinable mail and air mail from the entering mail stream, automatic fine culling to provide additional mechanical separation, and mechanical facing and cancelling of machinable mail. Additionally there are various manual operations to process the different categories of nonmachinable mail extracted from the process.

The Atlanta 010 operation consists of a centralized culling and distribution system--two parallel culling lines feeding a pyramid conveyor system which distributes mail to eight of the 10 facer-canceller machines. These eight machines (six Mark II's and two
NCR's) are automatically fed by Model 500 edger-feeder machines. One Mark II and one NCR are free-standing and hand-fed. This Mark II can be supplied with mail from the pyramid system through use of an edger-stacker machine or can process trayed mail brought directly from the dock.

The constraints imposed upon the system are basically of two types, physical resources and performance deadlines. The physical resources are documented in the sections of the report that follow, wherein the collection, dock handling, culling, and facer-canceller operations are described in more detail. Among the dock handling, culling, and facer-canceller operations there is considerable flexibility in switching labor assignments on a daily basis.

A subtle but very important flexibility is the ability of each operation to vary the quality of mail it delivers to the next operation. For example, if the culling system is overloaded, it will simply feed a poorer quality mail stream (more nonmachineable items) to the facer-cancellers. Thus, one operation can shift some of its work to the next, sometimes to the detriment of the overall 010,020 operation.

The basic performance deadline under which the 010,020 operation functions is that any mail deposited on the dock by 1900 hours must be processed by 2115 hours. This deadline is governed largely by the schedules of outgoing transport units and the time required for sorting mail. A consequence of this deadline is the peak-period nature of the 010,020 operation.
The system output consists of mail that has been separated into broad categories, and faced, cancelled, and trayed if necessary. For an "average day" the output consists of:

- 635,600 stamped letters; faced, cancelled, and trayed
- 483,000 meter letters; faced and trayed
- 10,800 stamped flats; faced and cancelled, in carts
- 66,600 meter flats; in carts
- 4,000 stamped slugs and SPR's; cancelled, in hampers
- 40,100 meter slugs and SPR's; in hampers

This represents a total of 1,240,100 pieces of mail per day being sent to the various sorting operations, such as manual letter sorting (035,040), letter sorting machine (080), flat sorting (060,070), and SPR sorting (110).

B. COLLECTION AND DOCK HANDLING

1. Description of Originating Mail. There are four major sources of originating mail:
   a. Collection Boxes
   b. Branches and Stations
   c. Large Volume Mailers
   d. Associate Offices

   The mail from collection boxes is ultimately transferred to appropriate branches and stations within the region. There are 32 branches and stations. Also there are other inputs to the branches and stations, such as "over the counter" customer
delivery and direct delivery by businesses in the branch/station areas. The mail collected at the branches and stations is transferred to the Federal Annex via numerous delivery runs throughout the day.

Large volume mailers constitute a sizeable group of businesses and firms in the downtown area referred to as the Central Business District (CBD). Typically, such customers are large retail businesses and service companies whose prime input is pretrayed and metered mail.

The last source of originating mail are the associate offices in the region. Such facilities are offices in outlying communities and towns.

In Phase I, data was collected relative to the volume, composition and form of the mail originating from branches and stations in the area. In addition, data was obtained relative to input from the CBD. The raw data from branches and stations was collected for an eight-day period by personnel at the facilities. The period extended from 7/18/74 through 7/26/74. Pertinent to the study was the volume of originating mail, and more importantly, the composition of such mail. Various categories were constructed: letters, metered and unmetered; slugs, flats, SPR's; air mail; and mixed mail. Appropriate weight-to-pieces conversions were made using published USPS factors. Analysis of the results of the study indicated that the volume and composition of mail brought to the Annex from
branches and stations varies greatly from run to run. Also, it was ascertained that a relatively low percentage of branches and stations combine for a rather significant portion of the total originating mail. In addition and of significant importance, it was judged from the data collected that the amount of pre-sorting at branches and stations is highly variable. Such variability was judged from the percentages of "mixed" originating mail reported during the study period.

The study of the CBD originations was not as extensive as that for the branches and stations; however, it was learned that major input from such sources is mail of the pretrayed form and within such a class much of the mail is metered and hence is capable of being routed by the 010 operation. The data for the entire study is summarized and tabulated in the 8/12/74 report, "Description of Mail Preparation Operations at the Atlanta Post Office."

2. Collection System Description. Primarily, the process of mail collection is the responsibility of three major groups which share, in varying degree, the collection obligation in what are often independent roles. The three groups are the Customer Services Group, the branches and stations themselves, and the Motor Vehicle Services Group.

The collections controlled by the Customer Services Group are largely confined to the CBD. In addition, a small number of branches and stations (3) near the CBD are also served by Customer Services.
Branches and stations are responsible for the routing and scheduling of all collections in their specific areas. Such collections include mail picked up by the carrier on morning delivery, receptions over the counter at the station, collection from drop boxes, collection from large users in the area, and collection from a few contract stations.

The Motor Vehicle Services (MVS) Group maintains the responsibility of collecting mail at the branches and stations and transporting it to the Federal Annex. Radio communication with vehicles is possible, and constant control is maintained in order to satisfy minimal daily requirements. The MVS group is located apart from the Federal Annex in its own facility a block away.

It should be noted that the Customer Services Group serves as a center of information for all collection activities, maintaining schedules and records of all collection operations performed by other groups in addition to their own.

3. Dock Handling Operations. The handling of originating mail on the receiving dock at the Federal Annex represents an important phase in the collection activities. Operations on the dock are fundamentally simple, yet the performance of such activities can have a substantial affect on the 010 operation. In essence, originating mail is delivered to the dock by delivery vehicles which tend to unload by zones; CBD vehicles in a given area, MVS in another, and so forth. The hampered and frequently, sacked mail is unloaded onto the dock by dock handlers. Often,
the vehicle driver aids in unloading as well.

Once the mail is removed from vehicles it may be handled a number of times before it eventually is dumped into the mail stream entering the Annex. Such handling may arise from the consolidation of partially filled hampers or from a rough cull by the dock handlers that attempts to remove nonmachinable mail prior to dumping. Such a cull is minimal, at best, and entails visual ascertainment of nonmachinable pieces and their removal and placement in presorting hampers, which are located at various points on the dock. Bypass mail (usually metered, pretrayed) is collected from vehicles, usually consolidated into hampers, and moved off the dock so as not to be mixed with other, mostly machinable pieces, which are dumped onto culling belts. A great amount of this bypass mail arrives from CBD runs.

Manpower at the dock typically consists of from 16 to 18 workers. During heavy loading periods as many as 23 workers may be utilized. The entire operation is managed by a single supervisor. The primary duties of the workers involve the unloading of arriving vehicles, handling mail flow on the dock, performing minimal culling activities, and transferring the mail to the dumping belts. In addition, the maintenance of each dumping mechanism occupies one operator whose duties center, primarily, around the dumping of arriving hampers of raw mail. The dumper operator also performs a cull of the mail as it is dumped onto the belts feeding into the Annex. There are two such dumping stations.
C. CULLING SYSTEM

1. Description of Mail Flows and Processes. The bulk of the mail on the dock is dumped from 80-pound hampers into two hoppers which feed a centralized, conveyor-belt distribution system. First, a manual cull is performed by about eight employees, who separate from the mixed mail stream the following items:
   1. air mail, into hamper, to air mail facility (AMF)
   2. meter flats, into hamper, to flat sorting
   3. meter slugs and SPR's, into hamper, to slug sorting
   4. stamped slugs and SPR's, into hamper, to slug cancelling
   5. bundled letters, onto conveyor
   6. stamped flats, onto conveyor

   The mailstream then passes through the automatic fine culling (AFC) machines, a one-roller machine on the west line and a three-roller machine on the east line. Reject mail from the west line is recycled through the east line here.

   The mail that passes through the AFC units consists essentially of letter mail with some flats and nonmachinable letters. The take-away conveyor belts CC-3 and CC-4 carry this mail to the surge belt CC-5, from which it proceeds to the pyramid slide and then to the vibrator feed hoppers.

   The reject mail from the east AFC proceeds to the reject belt. Here it is manually separated into the following categories:
   1. machinable stamped letters, into trays, to cancelling
   2. nonmachinable meter letters, into trays, to sorting
3. machinable meter letters, into trays, to sorting
4. air mail, into U-carts, to AMF
5. bundled meter letters, into U-carts to bundled letters belt
6. stamped flats, into U-carts, to flat belt
7. meter flats, into U-carts, to sorting
8. stamped slugs and SPR's into U-carts, to slug cancelling
9. meter slugs and SPR's, into U-carts, to slug sorting
10. hand stamp, into U-carts, to hand stamp operation
11. third class mail, into U-carts, to sorting

The residue on the reject belt consists of letters of varying machineability. These are reentered into the mailstream at the dumping hoppers, before the AFC's, after the AFC's or at the vibrator feed hoppers.

The stamped flats are transported by belt from manual culling to the flat belt. Here they are faced with the aid of a vertical belt conveyor and a stacker, and then cancelled on a portable canceller. Extraneous items in the mail stream on the take-away conveyor are culled out into hampers and U-carts.

1. meter flats, to flat sorting
2. meter slugs, to slug sorting
3. stamped slugs, to slug cancelling
4. air mail, to AMF
5. third class, to sorting
6. hand stamp, to hand stamp operation

Bundled meter letters are transported by belt from manual culling to the bundled letters belt. There the bundles are
broken and the letters trayed. This trayed mail goes directly
by manual push cart to LSM sorting.

Stamped slugs and SPR's are cancelled on two portable conveyor
belts, with the aid of fixed roller and hand-held roller cancellers.
This takes place near the flat belt, in an area under the
mezzanine. Thereafter, they are taken by hamper to slug sorting.

A considerable volume of mail comes from the dock in hampers
and enters the mailstream after the manual culling operation.
Most of the bundled letters, for example, are brought directly
to the bundled letters belt. Also, flats, and slugs and SPR's are
brought in directly to the flat belt, and the slug cancelling
areas, respectively.

Other mail bypasses the culling system completely, such as
Atlanta postmark letters, stamped trayed mail, and metered
trayed mail.

2. Centralized, Conveyor-Belt Distribution System. The operation of
the conveyor belts in the culling system is tied to the availability
of mail in the vibrator hoppers feeding the facer cancellers.
Photo-electric time-delay sensors are used to allow these hoppers
to call for mail when needed and to control the flow of mail to
the transport-surge conveyor belt CC-5. The sensors are
designated according to function:

height control sensor (HCS)
back-up sensor (BUS)
tail end sensor (TES)
speed control sensor (SCS)
These are typically mounted in hoppers, chutes, and at belt ends.

For example, an HCS and a BUS in each vibrator feed hopper control the distribution of mail by the pyramid slide. The flow of mail on the transport-surge conveyor CC-5 is governed by SCS's at its head end and by TES's at the points where take-away conveyors CC-3 and CC-4 feed it. The manual culling belts and the AFC's are also controlled by sensors and interlocked with the downstream belts.

After the mixed mailstream passes through the manual culling operation it enters the automatic fine culling units, shown schematically in Figure 2.1. The mail passing through the west AFC goes on to the pyramid, while that rejected is carried by a belt into the hopper for the east AFC, which also receives the mail from the east manual culling belt. The east AFC has two upper gauge rollers, the second gauging mail that passed under the first. Both rollers reject mail down a declined chute to another belt below, where the mail passes under the lower gauge roller. The rejected mail from this roller is carried to the reject belt for manual separation. Mail passing through either the second upper roller or the lower roller continues to flow to the pyramid.

A downtime analysis of the manual culling belts and the AFC's revealed some interesting disparities between the two culling lines (see 10/15/74 report). The east culling line was observed to be stopped considerably more than the west line.
Figure 2.1. Schematic Diagram of AFC's.
It was concluded that the reject mail from the west line was
overloading the feed hopper for the east line, causing that
AFC to be stopped from 32 to 37 per cent of the time during
observation periods. This led to the east manual culling line
stopped from 16 to 31 per cent of the time.


a. Average Flow Volumes at Points. The mailstreams within the
culling system were sampled to obtain estimates of flow
volumes and composition (see 8/12/74 report). Table 2.1
shows these volumes, in thousands of pieces, for a "weighted
average day." The total volume dumped onto the manual culling
belts is 1,137,000 pieces per day. Of this, only about half
are loose, machinable stamped letters. About 7 per cent
consists of flats, slugs, and SPR's.
### Table 2.1 Weighted Average Flow Volumes in Thousands of Pieces/Day

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>After</td>
<td>Before</td>
<td>After</td>
<td></td>
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<tr>
<td>Culling</td>
<td>Culling</td>
<td>Culling</td>
<td>Culling</td>
<td></td>
</tr>
<tr>
<td>On CC-1</td>
<td>On CC-1</td>
<td>On CC-2</td>
<td>On CC-2</td>
<td></td>
</tr>
</tbody>
</table>

1. Mach. Stamp. Let. 371.1 373.2 183.7 190.2
2. Nonmach. Stamp. Let. 13.9 15.8 4.9 8.5
4. Mach. Met. Let. 83.3 86.1 91.9 93.3
5. Nonmach. Met. Let. 2.9 6.0 2.0 3.2
6. Bundled Letters 136.4 10.0 101.9 33.0
7. Stamped Flats 11.8 3.8 11.1 7.1
8. Meter Flats 7.2 5.0 18.3 3.9
9. Stamped Slugs 11.8 7.9 2.6 2.2
10. Meter Slugs 5.3 3.9 6.2 1.6
11. Stamped SPR's .5 .4 1.2 .9
12. Meter SPR's 1.1 .4 2.7 .2
13. Air Mail 6.9 5.6 5.9 5.0
14. Other 2.7 1.0 .6 -----  
Total 682 546 455 371
Table 2.1, (Continued)

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mach. Stamp. Let.</td>
<td>348.8</td>
<td>24.4</td>
<td>13.8</td>
<td>3.4</td>
<td>2.0</td>
</tr>
<tr>
<td>2. Nonmach. Stamp. Let.</td>
<td>13.1</td>
<td>3.0</td>
<td>5.1</td>
<td>.2</td>
<td>---</td>
</tr>
<tr>
<td>3. Bus. Permit Let.</td>
<td>25.4</td>
<td>1.4</td>
<td>5.5</td>
<td>.2</td>
<td>---</td>
</tr>
<tr>
<td>4. Mach. Met. Let.</td>
<td>75.4</td>
<td>10.8</td>
<td>7.5</td>
<td>1.5</td>
<td>---</td>
</tr>
<tr>
<td>5. Nonmach. Met. Let.</td>
<td>5.2</td>
<td>.9</td>
<td>3.7</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>6. Bundled Letters</td>
<td>7.5</td>
<td>2.3</td>
<td>3.7</td>
<td>8.6</td>
<td>172.3</td>
</tr>
<tr>
<td>7. Stamped Flats</td>
<td>3.5</td>
<td>.3</td>
<td>1.1</td>
<td>9.5</td>
<td>.1</td>
</tr>
<tr>
<td>8. Meter Flats</td>
<td>4.8</td>
<td>.2</td>
<td>1.4</td>
<td>5.7</td>
<td>2.4</td>
</tr>
<tr>
<td>9. Stamped Slugs</td>
<td>2.4</td>
<td>5.5</td>
<td>7.1</td>
<td>.6</td>
<td>.4</td>
</tr>
<tr>
<td>10. Meter Slugs</td>
<td>2.4</td>
<td>1.6</td>
<td>6.4</td>
<td>.4</td>
<td>2.5</td>
</tr>
<tr>
<td>11. Stamped SPR's</td>
<td>.4</td>
<td>.1</td>
<td>.2</td>
<td>.1</td>
<td>---</td>
</tr>
<tr>
<td>12. Meter SPR's</td>
<td>---</td>
<td>.4</td>
<td>.1</td>
<td>.1</td>
<td>---</td>
</tr>
<tr>
<td>13. Air Mail</td>
<td>5.2</td>
<td>.4</td>
<td>1.7</td>
<td>.1</td>
<td>2.0</td>
</tr>
<tr>
<td>14. Other</td>
<td>---</td>
<td>.3</td>
<td>.4</td>
<td>.3</td>
<td>---</td>
</tr>
<tr>
<td>Total</td>
<td>494</td>
<td>52.4</td>
<td>58.1</td>
<td>30.9</td>
<td>181.6</td>
</tr>
</tbody>
</table>
b. Process Effectiveness. Table 2.1 provides information on mail composition before and after culling, and hence, the effectiveness of those operations. Of the bundled letters, flats, slugs, and SPR's in the entering mailstream, the following percentages are removed by manual culling:

- Bundled letters: 82%
- Flats: 59%
- Slugs: 40%
- SPR's: 65%

This apparently poor performance can be attributed to a number of factors, such as gaps in the mailstream, the belts being stopped, and the heavy mail volumes.

Of the mail that arrives at the flat belt FL-3, only 31 per cent is what it should be (stamped flats), the rest being largely bundled letters and meter flats. The figure on the bundled letters belt is considerably better; only 5 per cent of the mail there is of the wrong category.

Examining the automatic fine culling machines, it can be seen that the single-roller AFC-2 on the west line rejects mail which is about 70 per cent machinable, allowing most of the nonmachinable letters, bundled letters, slugs, and SPR's to proceed to the facer-cancellers. The mail arriving at the reject belt RE-4 is about 28 per cent machinable, showing the effectiveness of the multiple-roller system.
Varying the density of mail on the manual culling belts, while keeping the volume/worker constant, revealed that better culling is achieved when fewer workers are positioned on a belt (see 10/15/74 report). Experiments showed that about 75 per cent of flats, slugs, SPR's and air mail can be removed if one or two workers process 8 hampers/hour each. When four workers processed the same volume per worker, the percentage removed dropped to between 53 and 57 per cent.

D. EDGING, FEEDING, FACING, AND CANCELLING

1. Description of Machine Processes. These operations have as their objective the facing of letter mail to facilitate sorting on the LSM machines and the cancelling of stamped mail.
   a. System Description. There are 10 facer-canceller machines in the Atlanta Post Office:

<table>
<thead>
<tr>
<th>Machines</th>
<th>Model</th>
<th>Feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,3,4,5,8</td>
<td>Mark II</td>
<td>Model 500 Edger-Feeder</td>
</tr>
<tr>
<td>6,7</td>
<td>NCR</td>
<td>Model 500 Edger-Feeder</td>
</tr>
<tr>
<td>9</td>
<td>Mark II</td>
<td>Hand; Modified Edger-Stacker</td>
</tr>
<tr>
<td>10</td>
<td>NCR</td>
<td>Hand; Free Standing</td>
</tr>
</tbody>
</table>

   Machines 1 - 8 are supplied culled mail by a pyramid-conveyor system. This system can also supply mail to the edger-stackers adjacent to Machine 9. Machine 10, and usually Machine 9, are hand fed from trayed mail brought from the dock or from culling operations.
b. **Edger-Feeder.** Mail is dumped into the edger-feeder vibrator hopper from the pyramid system. It is carried up an inclined conveyor, where it is spread to a depth of one piece and dumped onto a horizontal conveyor. It then is passed through a thickness extractor and over a curved grill to fall into a horizontal chute, where a powered belt conveys it to the facer-canceller. Along the way, it passes through a height extractor. The final part of the edger-feeder system is a mechanism to control the mail so that only one piece at a time is fed to the facer-canceller.

c. **Facer Canceller.** The Mark II Facer-Canceller consists of two cancelling modules (A and B). Stamped mail or metered mail is identified by the luminescent properties of the stamp or indicia. If the stamp or indicia of a letter fed into the A module is bottom left (right) it is cancelled and diverted into the lead (trail) mechanical stacker of module A. Otherwise, it is inverted and sent to module B, where the same events take place. Mail not cancelled and stacked at modules A and B are sent to the bypass stacker. The NCR Service Test Modules operate in a somewhat similar manner. However, these machines can identify air mail stamps and require only two stackers to achieve proper facing of mail. Thus, the first two of five stackers contain regular cancelled and faced mail, the next two contain cancelled and faced air mail, and the last stacker is for bypass mail. A schematic diagram of the facer-canceller area is shown in Figure 2.2.
Figure 2.2 Schematic Diagram of the Facer-Canceller Area
2. **Pertinent Data.** A summary of statistical information collected during studies of the edger-feeder/facer-canceller system is given below. Details are contained in the Phase I report.

a. **Vibrator Hopper.** The edger-feeder vibrator hopper has the following contents:

<table>
<thead>
<tr>
<th>Type of Mail</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stamped letter mail</td>
<td>64.9%</td>
</tr>
<tr>
<td>Metered letter mail</td>
<td>27.2%</td>
</tr>
<tr>
<td>Business reply, penalty mail</td>
<td>4.4%</td>
</tr>
<tr>
<td>Letters with no postage</td>
<td>0.5%</td>
</tr>
<tr>
<td>Flats, slugs, bundles</td>
<td>3.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Approximately 5 per cent of the letter mail is nonmachinable, so that the amount of machinable mail reaching the edger-feeder is 92 per cent. About 98 per cent of the stamped letter mail and 87 per cent of the metered letter mail is "hot."

b. **Thicks Extractor.** Approximately 7 per cent of the input to the edger-feeder is removed by the thicks extractor. Of this amount 41 per cent is machinable mail and thus is removed in error.

c. **Heights Extractor.** About 6 per cent of the input to the edger-feeder is removed by the heights extractor. Of this amount, 45 per cent is error. Most of the errors have one side longer than 5 3/4 inches and are caused by improper edging.

d. **Facer-Cancellers.** The average number of pieces processed through a Mark II during the peak period is 17,000 pieces per clock hour. This drops to about 13,000 pieces per hour.
during the nonpeak period. The productivity of an NCR machine is 13,000 and 8,000 pieces per hour during peak and nonpeak periods, respectively.

The number of jams per productive hour on the Mark II averages 25-30, with an average duration of 0.3 minute per jam.

Approximately 92 per cent of A and B stacker contents are faced and cancelled properly. The remainder are either misfaced (7%) or not cancelled (1%).

About 19 per cent of the feed to the Mark II goes to the bypass stacker. Of the total contents of the bypass stacker, 49 per cent is "hot" and is in error. Of the stamped letter mail in the bypass stacker, 89 per cent is "hot"; 78 per cent of the metered mail is "hot."

E. PERFORMANCE MEASURES

In addition to the statistical information described previously, certain measures of overall performance were computed in Phase I. One measure of interest is the pieces of mail processed per man-hour in the 010 and 020 operations. This data is summarized in Section 1, below. A second set of measures is concerned with the productivity of the facer-canceller machines, including consideration of error rates. These results are given in Section 2, below.
1. **Volume/Man-Hour.** For the purpose of determining productivity in the 010 and 020 area, in terms of first pieces processed per man-hour, work days were classified into eight categories. A representative number of days in each category were selected randomly, covering the period from November 1, 1973 to November 1, 1974. Overlap among categories was allowed.

From the Work Load Recording System (WLRS) reports, the pieces processed and the man-hours charged were obtained for each sample day, except for 010 letters processed. In place of that item, figures for total letters cancelled were obtained from USPS Form 4791, facer-canceller meter readings, lines 2 plus 9. These figures were then averaged within each category. The category averages were then weighted to produce an "average day."

Appendix E shows the work day classification and weighting and the individual breakdowns of pieces processed and man-hours.

The resulting productivity figures thus obtained are as follows:

<table>
<thead>
<tr>
<th>Operation</th>
<th>Pieces/Day</th>
<th>Man-Hours/Day</th>
<th>Pieces/Man-Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>010</td>
<td>650,500</td>
<td>488.3</td>
<td>1,332</td>
</tr>
<tr>
<td>020</td>
<td>589,700</td>
<td>50.7</td>
<td>11,631</td>
</tr>
<tr>
<td>Combined</td>
<td>1,240,100</td>
<td>539.1</td>
<td>2,300</td>
</tr>
</tbody>
</table>

2. **Facer-Canceller Productivity.** In the Phase I report of 8/12/74, a number of performance measures for the facer-canceller operation are given. The table below summarizes the more important results:
1. Pieces Fed:
   Per Clock Hour 12,918 15,491 7,949
   Per Operating Hour 17,215 21,033 10,408
   Per Running Hour 20,169 21,745 13,210

2. Pieces Cancelled:
   Per Clock Hour 10,451 13,561 6,426
   Per Operating Hour 13,929 18,413 8,414
   Per Running Hour 16,318 19,036 10,801

3. Error Rate - Facing and Cancelling 8% 13% 6%

4. Pieces Faced and Cancelled Correctly:
   Per Clock Hour 9,614 11,798 6,040
   Per Operating Hour 12,815 16,019 7,909
   Per Running Hour 15,012 16,561 10,153

In the above, "operating time" means actual running time plus downtime because of jams. "Clock time" is operating time plus other nonproductive time (e.g., no mail, maintenance, no operator). "E/F" means edger-feeder, and "E/S" implies edger-stacker, or hand-fed operation.

III. CONCLUSIONS AND RECOMMENDATIONS

A. COLLECTION AND DOCK HANDLING

1. Presort Originating Mail at Branches and Stations.
   a. Discussion. The amount of mail transferred to the Federal Annex from branches and stations which is of a "mixed"
variety (no segregation) is highly variable relative to facilities. From an eight-day study, it was revealed that nearly 35 per cent of the branches and stations submitted mixed mail at levels over 25 per cent of their entire input.

b. Justification. The form in which mail arrives on the receiving dock is largely the form in which it is entered into the mail stream of 010. Hence, by instigating a presort at branches and stations relative to basic categories such as letters (metered, not metered); slugs, flats, SPR's; air mail, or even a presort of machinable and nonmachinable pieces, it would appear that purification of the input mail stream would be greatly enhanced.


(1) Assign dock workers to fixed jobs and if possible, to fixed locations.

(2) Maintain contingency or backup jobs.

(3) Clear bypass mail sooner.

(4) When feasible, make a one-to-one exchange of empty hampers for unloaded hampers from vehicles.

(5) Specify and maintain fixed locations on the dock for items such as presort hampers. In addition, specify fixed areas for hampers to queue prior to dumping.

(6) Eliminate multiple presort hampers that have low utilization.

(7) Perform a more rigorous cull at the dumping belts.

(8) Secure canvas sacks on hampers to the base of the hampers.

(9) Attempt to store empty hampers inside one another.
a. Discussion. In large measure the above recommendations are simple and self-explanatory. However, some clarification is warranted. Item (1) specifies an attempt to reduce the freedom of movement of workers on the dock. The congestion on the dock is often overwhelming and is due, in large part, to the volume of originating mail during heavy periods. However, a contribution to such congestion appeared to be the massive mixing of work flow patterns created by handlers that move continually within the work area.

Item (2) is suggested in order to aid in reducing the backlogging of work during peak periods. Often workers remain on jobs begun during less heavy periods and allow workloads to build up, causing further delay and congestion.

Item (3) is specified in order to hasten the transferral of bypass mail out of the area. A great amount of this mail comes from CBD deliveries and as such arrives near the dumping belts. In attempting to consolidate such mail into full hampers, it is often the case that when such hampers are ready to be moved out of the area, they are "locked" in due to arrivals (from the opposite direction on the dock) of raw mail that is to be dumped. Hence, it is suggested that bypass mail be moved sooner, even at the expense of moving smaller amounts more often.

Recommendation (4) is suggested in order to maintain a better balance of hampers in the system. It is not uncommon to have the total number of hampers on the dock increase
substantially over relatively short periods. Many such hampers are empty.

Item (8) is specified from frequent observation where the canvas sacks on hampers are loose, causing delays at the dumpers due to raw mail becoming "wedged" in the sacks. Hence, it is suggested that surveillance be made in order to insure that the sacks remain fixed to the base of the hamper.

b. Justification. The items recommended above require no real structural changes to the dock handling system. For the most part such changes can be effected quickly. It is clear that supervision will have to be exercised to make sure that certain of the items be carried out (e.g., (1), (2)). Nevertheless, the justification for the specification of the above recommendations centers around the need to enhance labor utilization on the dock and to conserve space and equipment availabilities.

B. CULLING SYSTEM

1. Improved Utilization of Labor.

(1) Implement a mail volume forecasting technique to determine daily and hourly labor requirements.

(2) Use hampers to provide more in-process inventories.

(3) Install timing devices and stiffer flaps on dumping hoppers to provide more uniform flow on culling belts.

(4) Eliminate movements of partial hamper loads.
a. **Discussion.** Observation of the culling system showed that the manual cullers were often unproductive because of gaps (7 to 18%) in the mailstream and stopped belts (up to 31% of time). At times there was no mail on the dock for dumping, and the entire centralized distribution system came to a virtual standstill.

Moreover, an analysis of labor productivity showed wide variations by day of week and day of month. Table 3.1 indicates a low of 1,088 pieces per man-hour in 010 operation, for ordinary days (Category G, Tuesdays, Wednesdays, Thursdays), and a high of 1,843 for Mondays (Category B). Evidently the system can operate, with no changes whatsoever, at a higher productivity if there is enough mail input to keep employees busy! Alternatively, a technique for forecasting total daily mail volumes would allow the 010 supervisor to schedule part-time employees in a rational manner, and thereby achieve a higher productivity. Similarly, hourly forecasting would achieve a finer degree of control.

b. **Justification.**

(1) Table 3.2 shows the potential labor savings if productivity in 010 operation, measured in pieces per man-hour, were raised to 1600, 1700, and 1800, respectively. Even if only 1600 is achieved, the savings in the culling system would represent about
Table 3.1. Pieces Processed per Man-Hour
in 010 Operation, by Type of Day

<table>
<thead>
<tr>
<th>Code</th>
<th>Sample Size</th>
<th>Type of Day</th>
<th>Pieces/Day in Thousands</th>
<th>Man-Hours per Day</th>
<th>Pieces per Man-Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6</td>
<td>Day after holiday</td>
<td>735.2</td>
<td>509.0</td>
<td>1,444</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>First day of week</td>
<td>789.0</td>
<td>428.1</td>
<td>1,843</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>Last day of week</td>
<td>695.9</td>
<td>583.3</td>
<td>1,193</td>
</tr>
<tr>
<td>D</td>
<td>7</td>
<td>First day of month</td>
<td>885.3</td>
<td>574.7</td>
<td>1,540</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>Last day of month</td>
<td>819.9</td>
<td>565.8</td>
<td>1,449</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
<td>Christmas rush</td>
<td>1,194.0</td>
<td>745.0</td>
<td>1,603</td>
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<td>G</td>
<td>9</td>
<td>Other</td>
<td>703.1</td>
<td>646.3</td>
<td>1,088</td>
</tr>
<tr>
<td>H</td>
<td>5</td>
<td>Weekends</td>
<td>325.5</td>
<td>233.8</td>
<td>1,392</td>
</tr>
<tr>
<td>Ave.</td>
<td>53</td>
<td>Weighted average</td>
<td>650.5</td>
<td>488.3</td>
<td>1,364.6</td>
</tr>
</tbody>
</table>

**Note:** The average of 1364 pieces per man-hour is the weighted average of the ratio of pieces/day to man-hours/day. An alternative way is to compute the ratio of the weighted average of pieces/day to the weighted average of man-hours per day. This latter method yields 1332 pieces/man-hour.
Table 3.2. Potential Labor Savings

<table>
<thead>
<tr>
<th>Code</th>
<th>1,800</th>
<th>1,700</th>
<th>1,600</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>408.4</td>
<td>432.5</td>
<td>459.5</td>
</tr>
<tr>
<td>B</td>
<td>438.3</td>
<td>464.1</td>
<td>493.1</td>
</tr>
<tr>
<td>C</td>
<td>386.6</td>
<td>409.4</td>
<td>434.9</td>
</tr>
<tr>
<td>D</td>
<td>491.8</td>
<td>520.8</td>
<td>553.3</td>
</tr>
<tr>
<td>E</td>
<td>455.5</td>
<td>482.3</td>
<td>512.4</td>
</tr>
<tr>
<td>F</td>
<td>663.3</td>
<td>702.4</td>
<td>746.2</td>
</tr>
<tr>
<td>G</td>
<td>390.6</td>
<td>413.6</td>
<td>439.4</td>
</tr>
<tr>
<td>H</td>
<td>180.8</td>
<td>191.5</td>
<td>203.4</td>
</tr>
<tr>
<td>Average</td>
<td>361.4</td>
<td>382.7</td>
<td>406.5</td>
</tr>
</tbody>
</table>

Savings 488.3 vs vs vs

Savings 126.9 105.6 81.8

Per cent 26% 22% 17%
27 man-hours per day at the various belt stations, and an undetermined savings in materials handling workers. The direct labor saving, excluding fringe benefits, would be

\[ 27 \times 365 \times 5.00 = 49,275 \text{ per year.} \]

Costs involved for the first year would consist largely of an engineer's time:

- 1 month at $1,200 = $1,200
- 11 months at \( \frac{1}{8} \times 1,200 = \frac{1,200}{8} = 150 \)

\[ 2,700 \]

There would be costs associated with computer usage, but this would be minor. The magnitude of the first year savings compared to costs renders discounted cash flow analysis unnecessary.

(2) Because of the interrelationships among numerous factors, it is difficult, if not impossible, to estimate the effects resulting from the second recommendation. This recommendation is directed primarily at the dumping activity on the dock. If eight (8) hampers are queued before dumping starts in the late afternoon, then about 30,000 pieces of mail will be delayed up to 30 minutes. The benefits will be elimination of some of the gaps on the culling belts. Because on most days there is slack at the various belt stations, it may be possible to delay shift starting times by up to 30 minutes. This would involve a maximum of about 24 employees,
producing a maximum possible annual benefit of

\[24 \times \frac{1}{2} \text{ hour} \times 5.00 \times 365 = $21,900.\]

The actual annual benefit to be realized will be some fraction, perhaps $\frac{1}{4}$, of this amount, or $5,475 in direct labor.

(3) It is expected that auditory timing devices and stiffer flaps at the dumping hopper will reduce gaps on the culling belts from 13% to 6%. Assuming the productivity of the cullers, when presented with mail, remains unchanged, the annual benefit to be realized would be

\[40 \text{ hours} \times 0.07 \times 5.00 \times 365 = $5,110.\]

The cost of the items is estimated to be less than $300.

(4) No specific benefits nor costs can be determined for the fourth recommendation. It is primarily intended to foster an attitude of steady-state efficiency, rather than pushing the mail to the next operation.

The potential benefits to be realized from all four recommendations are not directly additive. In fact, a complete implementation of the first may preclude any benefits from the other three. Thus, it is considered that the maximum annual benefit from all four would be about $50,000 annually in direct labor saving. In essence then, the other three recommendations would simply help insure that the first achieved its goal.
c. **USPS Reaction.** The reaction of USPS personnel was somewhat mixed, and negative on the forecasting technique. Evidently, previous experiences with forecasting models involved several man-months of input and no useful results. Atlanta Engineering seemed willing to try an in-process inventory before the dumping hoppers, provided the downstream effects were explained. More details were requested on the third recommendation, and the fourth one was accepted.

d. **Implementation.**

(1) It is recommended that a forecasting model be constructed for total daily 010 volume and 020 volume. The data gathered by the research team indicates that such a model could provide useful results if the important factors for mail volume were isolated. Table 3.3 shows the category variances for the eight categories selected for demonstration. Some categories show remarkable consistency for 010 volumes, such as B and C. The variations for category A can be explained by the fact that there are two types of days after a holiday. An example of the first is 5 July, which experiences much of the mail intended for 4 July. An example of the second is the day after Thanksgiving, experiencing very little mail because it is nearly a holiday itself.

The previous type of analysis needs to be done, with the consultation of USPS supervisors, to identify those factors influencing total daily volume. This information
can then be used for general increases or decreases in staffing levels. Once this has been implemented and tested, an hourly forecasting technique should be examined, using input data from dock arrivals.

Table 3.3. Total Daily Mail Volumes for 010,020 Operation
000’s pieces

<table>
<thead>
<tr>
<th>Code</th>
<th>Type of Day</th>
<th>010 Volume</th>
<th>010 Std. Dev</th>
<th>020 Volume</th>
<th>020 Std. Dev</th>
<th>010,020 Volume</th>
<th>010,020 Std. Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Day after holiday</td>
<td>735.2</td>
<td>233</td>
<td>613.4</td>
<td>206</td>
<td>1348.6</td>
<td>422</td>
</tr>
<tr>
<td>B</td>
<td>First day of week</td>
<td>789.0</td>
<td>52</td>
<td>649.5</td>
<td>135</td>
<td>1438.5</td>
<td>127</td>
</tr>
<tr>
<td>C</td>
<td>Last day of week</td>
<td>695.9</td>
<td>26</td>
<td>772.5</td>
<td>127</td>
<td>1468.5</td>
<td>139</td>
</tr>
<tr>
<td>D</td>
<td>First day of month</td>
<td>885.3</td>
<td>157</td>
<td>806.4</td>
<td>192</td>
<td>1691.8</td>
<td>284</td>
</tr>
<tr>
<td>E</td>
<td>Last day of month</td>
<td>819.9</td>
<td>101</td>
<td>815.6</td>
<td>135</td>
<td>1635.5</td>
<td>166</td>
</tr>
<tr>
<td>F</td>
<td>Christmas rush</td>
<td>1194.0</td>
<td>109</td>
<td>811.3</td>
<td>218</td>
<td>2005.2</td>
<td>112</td>
</tr>
<tr>
<td>G</td>
<td>Other</td>
<td>703.1</td>
<td>78</td>
<td>845.9</td>
<td>105</td>
<td>1549.0</td>
<td>144</td>
</tr>
<tr>
<td>H</td>
<td>Weekends</td>
<td>325.5</td>
<td>136</td>
<td>108.6</td>
<td>78</td>
<td>434.1</td>
<td>206</td>
</tr>
</tbody>
</table>
(2) It is recommended that dumping in the afternoon commence only when eight hampers are queued.

(3) Appendix A contains brief specifications for the auditory timing device. It is recommended that 3/8" rubber tire material be tried for the flaps.

(4) Implementation involves worker instruction by supervisors.

2. Change Automatic Fine Culler Configuration.

   (1) Eliminate belt RE-1 and convert both lines to identical upper-lower roller units.

   (2) Change the delay time on AFC-3 from 4 to 2 seconds.

   a. Discussion. These recommendations are intended to eliminate excessive downtime on the east line caused by the reject mail from the west line overloading the east feeding hopper. Such downtime results in underutilized labor at the culling belt, and the overloading results in the jamming of the east AFC. Controlled experiments showed that the downtime on the east line could be reduced from the range of 16 to 31% to virtually zero (see 10/15/74 report).

      The delay time on AFC-3 appears to result in an uneven flow of mail on the take-away conveyor, and occasional shutdowns of the east culling belt. The west line AFC operates with a 2-second delay and appears to function smoothly.

   b. Justification. It is expected that the labor productivity on the east culling line will increase by about 12%, resulting in about

      \[ 16 \times 0.12 \times \$5.00 \times 365 = \$3,500 \]
direct labor saving per year. The cost of the change is
difficult to estimate because no accurate salvage value can
be determined for the existing west line AFC. If its
salvage value is ignored, and a $15,000 installed cost is
used for a new AFC, a 5-year comparison of benefits and costs
yields a benefit-cost ratio of

\[
\frac{P/A 10\%, 5}{3,500 \left(\frac{3.791}{15,000}\right)} = 0.88.
\]

This low ratio is the result of the high cost of the AFC,
and the expected short lifetime of the present central
facility.

c. **USPS Reaction.** At the time of the initial recommendation,
USPS personnel requested details on the cost of the change in
configuration. The change in delay time would require a few
minutes of a mechanic's time, and thus was acceptable.

d. **Implementation.** It is recommended that the delay time on
AFC-3 be changed from 4 to 2 seconds. Unless a used AFC
can be obtained at low cost, the changed configuration is
not recommended because of its high cost and short benefit
period.

3. **Thin Out the Mailstream on Culling Belts.** It is recommended that
when the culling volume exceeds that for two cullers, or about
15 hampers/hour, both belts should be operated, with the cullers
evenly divided between the two belts.
a. **Discussion.** When the density of mail on the culling belts was varied, while keeping the volume/worker constant, it was determined that better performance was achieved with lower densities.

b. **Justification.** The recommendation can be implemented at virtually no cost, with the benefits being better culling.

c. **USPS Reaction.** USPS personnel agreed to try it.

d. **Implementation.** Short-range implementation presents no problem. The long-run implications are that the Atlanta facility may need more culling lines or a modular system. No long-run recommendations are made.

4. **Decreased Congestion and Task Simplification.**

   (1) Move the SPR and slug cancelling operation near the 110 operation.

   (2) Shorten the reject belt RE-3 to widen aisle.

   (3) At manual culling eliminate distinction between stamped and meter SPR's and slugs.

   (4) Have manual cullers toss into U-carts at their elbows instead of into hampers behind them.

   (5) Establish an activity on the dock for separating faced and stacked stamped letters.

   (6) Eliminate input at plexiglass window at CC-4.

   (7) Set up tables for sorting flats brought in directly from the dock.

   (8) Post task instructions for all employees.
a. Discussion and Justification. These recommendations are designed to relieve congestion and make it easier for the employees to perform their tasks. No definite impacts can be determined for these because of the sporadic nature of congestion effects and because of the difficulty of detecting resulting productivity changes without long-term observations. None of the recommendations involve more than nominal costs, on the other hand.

The first item is intended to remove two-thirds of the stamped slugs and SPR movement through the aisle bottleneck by the control panel.

The third item would involve about two additional man-hours per day at slug and SPR cancelling, with an expected offsetting productivity increase at manual culling due to the smaller number of classifications.

The fourth item is designed to make the manual cullers' work easier, and, hopefully, to improve their accuracy. To the extent possible, each culler should have his own U-carts so his work can be inspected.

Numerous observations of faced and stacked stamped letters, usually in manufacturers' envelope boxes, led to the fifth item. In essence, this means the dock sorting activity needs to be improved, including that at the dumping hoppers.

The sixth item is intended to relieve congestion at the major personnel aisle near CC-4. Likewise, the seventh
is aimed at relocating an activity that on occasion occurred across a major aisle.

The last recommendation concerns the consistency with which different employees perform the same task. On numerous occasions two workers side by side differed as to method. At other times one employee undid another's work. The effectiveness of each worker can be increased by clear instructions posted in strategic places. These should define the types of mail and tell the employee what to do with each type.

b. USPS Reaction. USPS reaction ranged from favorable to negative, with some requests for more information, detailed sketches, and so forth. Recommendation number three was rejected on the grounds that it would delay mail arrival at the 110 operation. More details were requested for items one, four, five, six, seven, and eight.

c. Implementation.

(1) Appendix B contains a sketch showing how the slug and SPR cancelling could be accommodated near the 110 operation. The 110 feed belt and the pouch rack area would be reoriented. The dock staging area would eventually lose some floor space in this change, but observations on busy evenings indicate that this would not present problems. Some hamper and U-cart storage would have to be relocated, also.

(2) This recommendation is subject to adequate space being available for workers at the reject belt.
(3) This recommendation is dropped.

(4) Appendix C contains a sketch of the proposed layout.

   This represents a slight compromise from the concept of each employee having his own U-carts, because of lack of space. It is recommended that the floor area be marked with the U-carts' positions.

(5) Implementation here consists of closer supervision on the dock, especially at the dumping hoppers.

(6) It is recommended that machinable letters be fed into vibrator feed hoppers for facer-cancellers 2, 3, and 4, thereby avoiding congestion in the aisle.

(7) Implementation of the first item renders this item nearly inconsequential, since there would be more work space near the flat belt.

(8) Appendix D contains a sample list of instructions.

5. **Other, Long-Range Recommendations.** The following items require a longer period for development and analysis and are beyond the scope of this study. Because they relate to some of the other recommendations presented here, however, it is considered appropriate to mention them.

   (1) Eliminate the dumping of mail that consists largely of machinable letters, thereby simplifying the culling task.

   (2) Redesign all workplaces to incorporate metal slides, thereby eliminating all tossing of mail.

   (3) Add more culling capability either by adding one or two more lines or by converting to a modular system.
C. EDGER-FEEDER/FACER-CANCELLER SYSTEM

1. Recycling of Bypass Stackers' Contents. It is recommended to reprocess the bypass stackers' contents by hand feeding on machine 10, or 9, if available. This would result in saving approximately 35 man-hours per day.

a. Discussion. Due to various reasons including double feeding, skewness of letters as they go through the facer-canceller, and problems in the sensor mechanism, a large portion (approximately 49%) of the contents of the bypass stackers consists of "hot" metered mail and uncancelled stamped letter mail, and hence represents an error. Currently, the bypassed mail is sent to operation 035. The uncancelled stamped letter mail is sorted and then sent to the flyers to be cancelled, and then back to 035 or 080. These operations can be eliminated by using the more efficient operation of hand feeding the contents of the bypass stackers through a facer-canceller machine.

b. Justification. In order to justify the recycling process, a trade-off between increasing the load on the facer-cancellers and the savings in the 035 and the flyer cancellation operations is made. A schematic flow diagram of the current plan and the proposed plan is shown below, where $\alpha$ is the percentage of error in the bypass stackers, i.e., $\alpha$ is the fraction of "hot" meter mail and uncancelled stamped letter mail in the bypass stackers. It is assumed
that all such letter mail will be faced and cancelled from recycling (our experimentation supports this assumption). Since $1-\alpha$ of the bypass stacker contents are treated identically in both plans, they will be deleted from the analysis below.

Current Plan

```
Bypass Stackers
  \alpha
  1-\alpha
  035
  035
  \frac{\alpha}{2}
  \frac{\alpha}{2}
  \text{either or}
  035
  080
```

Proposed Plan

```
Bypass Stackers
  \alpha
  1-\alpha
  080
  035
```

Consider an average day of 800,000 pieces sent to the facer-cancellers. The bypass stackers represent roughly 100,000 pieces per day, which is approximately 13 per cent of the total volume. The number of bypass errors is therefore 100,000 $\alpha$. Assume 50 per cent of these are metered mail.
The productivity of hand feeding, flyers, 035, and 080 are respectively 18,000, 4,800, 1,100, and 1,800 pieces per man-hour. If a switch is made to the proposed plan, the following increase and savings in man-hours are realized.

**Increase in Man-Hours:**

1. Processing through facer-canceller \[ \frac{100,000}{18,000} = 5.56 \]
2. Processing through 080 \[ \frac{100,000a}{1,800} = 55.6a \]
   Total increase 5.56 +55.6a

**Savings in Man-Hours:**

1. Processing through 035 \[ \frac{100,000a}{1,100} = 90.9a \]
2. Processing on Flyers \[ (0.5) \left( \frac{100,000a}{4,800} \right) = 10.4a \]
3. Either to 035 or to 080 \[ \frac{1}{4} \left( \frac{100,000a}{1,100} \right) + \frac{100,000a}{1,800} = 36.6a \]
   Total savings \[ = 137.9a \]

**Net Savings:**

\[ 137.9a - 5.56 - 55.6a = 82.3a - 5.56 \]

Obviously the net savings are a function of the percentage error. Note that if \( a = 0.49 \), the savings per day are approximately 36 man-hours. The relationship between the percentage error in the bypass stackers and the savings
realized is shown below. It is clear that even if the error rate is reduced to 20%, switching to the proposed plan would still give a substantial saving of 10.9 man-hours daily.

c. **USPS Reaction.** The reaction of the USPS staff to this recommendation is mixed. Several staff members feel that recycling the mail will put another burden on the face-canceller machines; for example, a daily volume of 800,000 results in an equivalent 900,000 pieces, since approximately an additional 100,000 extra pieces must be recycled. The above analysis shows that even though a heavier load is placed on the facing-cancelling operation, a major saving is realized if the overall system is considered. The key
factor is then the answer to the following question: can the facer-cancellers handle this extra volume and still meet the 9:15 p.m. deadline? The answer to this question is yes. During many visitations of the members of the study team, it was observed that the NCR machine (Number 10) is idle most of the time. Even during the peak period, a small volume is handled by Machine 10, usually not more than 15,000 pieces. Machine 10 can be utilized to hand feed the contents of the bypass stackers. A complete scheduling profile is provided in recommendation number 3 below and shows feasibility of recycling.

As far as the effect of this recommendation on the overall process downstream, it is clear that the recommendation would tend to make mail available at 080 earlier once the flyer operation is eliminated.

d. **Implementation Considerations.** The implementation of this recommendation does not require additional resources. As discussed above, the implementation would utilize Machine 10 for hand feeding the contents of the bypass stackers. Recycling the contents of the bypass stackers may first be attempted on a trial basis.

2. **Inclination of the Conveyor Belt on Edger-Feeders.** It is recommended to reduce the inclination of the conveyor belt from the current setting of 40.3° to an inclination of 38.1° and to use the maximum belt speed of 45 feet per minute. This results in
increasing the throughput of the conveyor belt from 27,000 pieces per hour to 33,000 pieces per hour. This is expected to increase the average throughput of the Mark II facer-cancellers from 17,000 to 20,800 pieces per hour.

a. Discussion. During the visitation of members of the study team to the Atlanta Post Office facility, it was observed that a large portion of the mail on the conveyor belt from the vibrator hopper to the edger/feeder slides backwards. This reduces the throughput of the edger/feeder and adds to the problem of nonuniform feed to the facer/canceller, thus leading to machine "starvation." In an attempt to overcome this difficulty, the effects of the belt inclination and belt speed on the throughput of the conveyor belt was studied. In order to eliminate intermittent stoppage of the conveyor belt due to jamming of the facer/canceller, the throughput from the belt was made to bypass the facer/canceller. A 2-factor experiment was designed to study the effects of the inclination and speed of the belt, and their interaction. The angle of the belt is controlled by adjusting the height of front and rear "legs." The current setting resulting in an angle of 40.3° is shown below.
The angle can be reduced by increasing the height of the rear leg. Also the belt speed can be adjusted on a scale from 0 to 45 feet per minute.

b. **Justification.** As discussed above, a 2 x 2 factorial experiment was performed. The speed was fixed at two levels, the maximum speed of 45 feet per minute and a lower speed of 33.75 feet per minute. The inclination was fixed at two levels, the maximum inclination of $40.3^\circ$ and a lower inclination obtained by raising the front leg by 0.75 inches and lowering the rear leg by 0.75 inches, giving an angle of $39.3^\circ$. The throughput at the corresponding four experimental settings in equivalent pieces per hour is summarized below. In each case a continuous feed of mail was provided to the vibrator hopper.

```
<table>
<thead>
<tr>
<th>Belt Speed</th>
<th>33.75</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclination</td>
<td>40.3^\circ</td>
<td>27,200</td>
</tr>
<tr>
<td></td>
<td>39.3^\circ</td>
<td>27,100</td>
</tr>
<tr>
<td></td>
<td>38.1^\circ</td>
<td>25,400</td>
</tr>
<tr>
<td>Speed</td>
<td>33,000</td>
<td>29,300</td>
</tr>
<tr>
<td></td>
<td>33,000</td>
<td>33,000</td>
</tr>
</tbody>
</table>
```

The above figure shows that at the current setting of high speed/high inclination, the throughput is 27,100 (of course during actual operation this throughput will not be realized since any jams in the facer/canceller would automatically stop the conveyor belt). The figure also shows a large
degree of interaction between the belt inclination and the speed. The highest throughput of 29,300 pieces per hour was obtained at the maximum speed and the lower inclination of 39.3°.

Having increased the throughput by reducing the angle, it was decided to reduce the angle further. This was done in a separate experiment where the front leg was raised by 1" and the rear leg was lowered by 2" leading to the following set up with inclination 38.1°.

```
  64"
  
  24"

  51"
```

This inclination together with the maximum belt speed produced the highest throughput of 33,000 pieces per hour. From this it is seen that the throughput of the conveyor belt can be increased from the current rate of 27,100 pieces per hour to 33,000 pieces per hour by decreasing the incline as discussed.

c. **USPS Reaction.** The reaction of the USPS staff to this recommendation was quite positive. The difficulty of obtaining an adequate feed in considered a major problem by the USPS staff and several alternatives for reducing the problem
were considered. These included reducing the incline, using newer belts with different configuration and coefficient of friction, using rollers on the belt to reduce sliding of the mail, and so on.

d. **Implementation Considerations.** Implementation of this recommendation is very simple and can be carried out immediately. It is emphasized, however, that the increase of throughput is realized only if proper continuous feed to the vibrator hopper is insured. If necessary, it is recommended to use fewer machines such that a continuous feed is provided to each machine. In order to determine the effect of changing the incline on the overall edger-feeder/facer-canceller system, it is recommended that the Atlanta Post Office staff perform the following experiment, say on Machine 8. The speed of the incline belt is set at its maximum and the angle at the minimal value described above. The throughput from the incline belt is fed to the facer-canceller and the number of pieces fed to the facer-canceller per hour is determined. The experiment must be performed by providing a continuous feed of mail at the vibrator hopper of the machine. The Atlanta Post Office staff is also considering the effect of a different belt material on the throughput of the conveyor belt and the overall edger-feeder/facer-canceller mechanism.

e. **Expected Results.** The current average throughput of the Mark II machines during the peak hours is approximately
17,000 pieces per hour. It is generally expected that the throughput will increase by a factor of 33,000/27,000, i.e. by a factor of 1.22, as the incline is reduced as discussed. This is expected to provide a facer/canceller throughput of 17,000 x 1.22, which is roughly 20,800 pieces per hour.

Further experimentation as described above is needed to test the validity of this expectation.

3. **Machine Scheduling (with recycling).** The following profile for scheduling of the machines is recommended. This schedule would handle a daily volume of 800,000 pieces of mail fed to the facer-cancellers. Due to recycling of the contents of the bypass stackers, this is equivalent to a volume of 904,000 pieces of mail. The schedule would result in a saving from 10 to 12 man-hours and would meet the 9:15 p.m. deadline. Machine 10 is used exclusively for the recycled mail.
a. **Discussion.** Scheduling of the machines depends to a large extent on the total volume and the arrival pattern of mail. As an attempt to approximate this information, the number of equivalent full 80-pound hampers being dumped at the two main dumping stations was observed. This led to the following chart of the percentage of volume dumped during certain intervals of the day.

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Percentage of Volume Dumped</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>9.3</td>
</tr>
<tr>
<td>3</td>
<td>10.6</td>
</tr>
<tr>
<td>4</td>
<td>14.2</td>
</tr>
<tr>
<td>5</td>
<td>18.1</td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>27.1</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>8:30</td>
<td>12.7</td>
</tr>
</tbody>
</table>

Assuming that the contents of the mail over the dumping period from 2 p.m. to 8:30 p.m. are uniform, the number of pieces fed to the facer-cancellers can be estimated as follows. Consider a typical day with 800,000 pieces of mail fed to the facer-cancellers. Then approximately $0.093 \times 800,000$ pieces of mail are to be fed between 2 and 3 p.m., $0.08 \times 800,000$ pieces of mail are to be fed between 3 and 4 p.m., etc. Adding 13% of this volume due to recycling, an approximate profile of the number of pieces to be fed to the facer-canceller machines as a function of time of day can be provided. Assume that the productivity of a Mark II machine is 20,800 pieces per hour (17,000 times a factor of
1.22 achieved by reducing the incline of the conveyor belt is discussed in 2. above), the productivity of a machine-fed NCR is 13,000 pieces per hour, and the productivity of the hand-fed NCR machine number 10 is 18,000 pieces per hour. The figure below shows the total pieces fed and the maximum number of pieces that can be processed by the scheduled machines during any period of time. These do not include the recycled mail which is processed on Machine 10 as will be discussed later. If the pieces fed are greater than the maximum pieces that can be processed during any period, then an overflow would result. Note that an accumulation of the mail during the period 7 - 8:30 p.m. is realized since the number of pieces fed exceeds the capabilities of the scheduled machines. However, since the flow stops at 8:30 p.m., the suggested schedule would process the mail by approximately 9 p.m., thus meeting the 9:15 p.m. deadline.

![Graphical representation](image-url)
Using 13% as the ratio of the bypassed mail to the total pieces fed, the figure below illustrates the cumulative number of pieces fed to Machine 10 as a function of time. Using 18,000 pieces per as the productivity of Machine 10, the figure also shows that the recycled mail will be processed by 9:13 p.m., thus meeting the deadline.
b. **Justification.** The above analysis shows a procedure for scheduling the machines so as to meet the deadline of 9:15 p.m. and to make good utilization of the machine's capabilities. The analysis is based on a typical volume of 800,000 pieces of mail fed to the facer-cancellers plus the recycled mail. A similar analysis can be made for a larger volume. The key point is that rather than using a larger number of machines with low productivity, a smaller number of machines with higher productivity (due to better feeding per machine) can be used. The analysis is based on the following assumptions:

1. A Mark II machine has an average productivity of 20,800 pieces per hour.
2. A machine-fed NCR machine has an average productivity of 13,000 pieces per hour.
3. A hand-fed NCR (Machine 10) has an average productivity of 18,000 pieces per hour. The above figures are realistic, especially when coupled with reducing the incline of the conveyor belt (see III-C-2-e above).
4. Machine 10 is used exclusively for the recycled mail from the bypass stackers.

Using the above scheduling profile would result in saving from 10 to 13 man-hours over the present scheduling system, which usually utilizes 5 or 6 machines in the period from 2 to 6 p.m., and all the machines (perhaps with the exception of Machine 10) in the peak period from 6 to 9 p.m.
c. **Implementation Considerations.** The above scheduling profile can be tried on an experimental basis. Due to the presence of many uncontrollable factors such as the total volume, the pattern of mail arrival, the mixture of mail, failure of the machines, etc., a perfect schedule is almost impossible to design apriori. It is felt, however, that the above analysis takes into consideration a good many of these factors. The operations supervisor may have to deviate slightly from the proposed schedule due to fluctuations of the volume. The recommended work load forecasting system (III-B-1) would facilitate implementation of this recommendation.

4. **Edging of the Mail.** Install an additional metal plate prior to the height extractor for the purpose of securing a more effective edging of the mail.

a. **Discussion.** On sampling the contents of the heights extractor, it was found that approximately 45% of the volume consists of nonflats with one side or two sides less than 5 3/4". This error can be substantially reduced if the mail were properly edged.

b. **Justification.** Currently a swinging steel plate is used as an aiding device for proper edging of the mail. Due to the lightness of the plate, the device is not doing an effective edging. It is felt that installing an additional plate will reduce the error of the height extractor. Other alternatives may be found by investigating practices at other postal facilities.
The following analysis shows the importance of doing an effective edging of the mail. Assuming a daily volume of 800,000 pieces of mail, approximately 50,000 pieces are removed by the heights extractor. Approximately 20,000 pieces have at least one side which is less than 5 3/4" and are sent to operation 035 with a productivity of 1,100 pieces per man-hour, which takes up 18.2 man-hours. Had these pieces been properly edged, they would go through the facer-canceller in one hour. Ignoring other man-hours involved (flyers after operation 035, man-hours spent in manually sorting the flats and the nonflats, bypass stackers, etc.) a potential savings of 17.2 man-hours per day can be realized.

c. Implementation Considerations. This recommendation can be tried on an experimental basis on one of the NCR machines, say Machine 6. It is suggested that an additional metal plate be temporarily fixed at different positions, each time sampling the error in the mail removed by the heights extractor. The position with the least error can then be used.

5. **Improve the Quality of Maintenance of the Facer-Canceller Machines.** It is recommended that attention be given to improving the maintenance provided for the facer-canceller machines. Alternatives include using the highest skilled local technicians for machine maintenance, accelerating the training of maintenance personnel usually assigned to operation 010, and bringing in outside personnel highly qualified in Mark II maintenance.
a. **Discussion.** The results of sampling studies, reported in the Phase I report of August 12, 1974, indicated high error rates for the Mark II facer-cancellers. The A and B stackers contained 7 per cent misfaced mail and 1 per cent not cancelled, adding to an 8 per cent error rate. The bypass stackers contained 30 per cent metered mail and 29 per cent stamped mail. Of this amount 78 per cent of the metered mail and 89 per cent of the stamped mail were "hot" under an ultraviolet light. This means that almost 50 per cent of the bypass mail should have been faced and cancelled.

From discussions with USPS engineering personnel, it appears that these are high error rates. USPS Publication 36 (November 1974), "Mechanized Mail Preparation, Fiscal Year 1975, A guide to Optimum Performance," gives the following goals as indicative of acceptable performance:

<table>
<thead>
<tr>
<th>Goal is Less Than</th>
<th>Atlanta Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Cent Bypass Mail</td>
<td>12%</td>
</tr>
<tr>
<td>Per Cent Bypass Meter Mail</td>
<td>1%</td>
</tr>
<tr>
<td>Per Cent Improperly Faced</td>
<td>5%</td>
</tr>
<tr>
<td>Per Cent Bypass Error</td>
<td>15%</td>
</tr>
</tbody>
</table>

Reasons for the high level of errors could be inadequate maintenance, faulty adjustment, or inherent lack of machine capability to do better.
The Atlanta Post Office has experienced difficulties recently in providing experienced trained maintenance manpower to carry out the required maintenance on the facer-canceller machines (for the 10 machines, some 30 hours of preventive maintenance are required each day). The problems result from the loss of approximately 26 trained maintenance employees to the Bulk Mail Facility early in 1974. While replacements have been hired from outside the Postal Service, it has been difficult to schedule their training.

Apparently the mass transfers were due largely to the Bulk Mail maintenance program offering higher grade levels than were available at the Atlanta Post Office. Because of the significant impact of such large transfers on the operations of a facility transfer policies should be reassessed (to whatever extent this is possible). Also it would be desirable to reevaluate the maintenance operations in the 010 area to determine if these jobs are properly evaluated relative to other maintenance positions.

b. Justification. The benefits from reduction of facer-canceller error rates are of the same nature as those described in analyzing the desirability of recycling the bypassed mail (Section III-C-1); however, by properly facing and cancelling the mail on the first pass there would be no need for processing in 035, as is now done, or for recycling, as is proposed. Improved maintenance should also lead to fewer machine stops and less demand maintenance.
6. **Establish Additional Controls on Facer-Canceller Operations.**

Implement effective control procedures to periodically measure and evaluate performance of the edger-feeder/facer-canceller system.

a. **Discussion.** Poor performance in terms of low productivity and high error rates can be experienced in the facer-canceller operation for a number of reasons—some related to the mechanical system and some related to operator performance. Good management control requires periodic monitoring of key variables that indicate performance quality. This data should be gathered in such a way that abnormal, or out-of-control conditions can be detected and their causes identified. The system should then require positive corrective action.

The data collection and reporting system described in "Mechanized Mail Preparation, Fiscal Year 1975, A Guide to Optimum Performance" (Publication 36, November 1974), can serve as the basis for effective control. It is understood that Atlanta Engineering is developing a reporting system based on this document. This activity should be continued. In that regard, it is suggested that statistical control charts, using the information provided by the system, be established to monitor key process variables, such as the following:

- Per Cent Bypass (by machine)
- Per Cent Improperly Faced (by machine)
- Per Cent of Input that is Bypass Metered Mail (by machine)
Per Cent Bypass Error (by machine)
Quantity Faced (by machine)
Machine Availability (by machine)

Atlanta Engineering personnel are familiar with statistical control chart techniques.

b. **Justification.** It is difficult to quantify the benefits from the recommended program; however, it is felt that the added ability to monitor the performance of the machines, identify trends, isolate problem areas, and otherwise have a closer control over operations should be of importance to management and engineering. The control chart analysis will permit determination of the natural capabilities of the individual machines, identification of significant variation in performance, and recognition of trends. Also, control charts give a visual representation of performance over time and their presence gives tangible evidence of management's interest in performance quality.
APPENDIX A

BRIEF DESCRIPTION OF TIMING DEVICE FOR DUMPING HOPPER

1. Type: Interval timer
2. Runs continuously, resets automatically, manual override reset
3. Intervals of 1 to 15 minutes, 30 second divisions.
4. Intervals to be easily adjustable
5. Interval buzzer, 1/2 second duration
6. Rheostat to control buzzer volume by screwdriver inserted into panel
7. Power source, 230V, 60 cycle
8. To be mounted on brick wall
APPENDIX B

PROPOSED RELOCATION OF SPR CANCELLING
O CULLER
MF METER FLATS
MS METER SPR's, SLUGS
SS STAMPED SPR's, SLUGS
AM AIR MAIL

SCALE \( \frac{1}{8}" = 1' \)

APPENDIX C

PROPOSED MANUAL CULLING LAYOUT (U-CARTS)
APPENDIX D

SAMPLE LISTS OF TASK INSTRUCTIONS

TO BE POSTED FOR EMPLOYEES
DEFINITIONS (to be posted at all stations)

1. FLATS: large, thin envelopes more than 5 3/4" by 5 3/4" and less than 1/4" thick
2. SLUGS: any envelope over 1/4" thick
3. SPR'S: small parcels and rolls
4. NONMACHINABLE LETTERS: bent, torn, and flimsy letters

CULLING (what to do)

1. Only loose letters should be left on belt. Cull all other types:
   - Bundled meter letters on belt BU-3.
   - Stamped flats on belt FL-1.
   - Airmail in cart.
   - Stamped slugs and SPR's in cart.
   - Meter slugs and SPR's in cart.
   - Meter flats in cart.
   - Nonmachinable letters in tray.
2. Break bundled stamped letters and leave on belt.

CULLING (where things go)

1. Stamped slugs and SPR's go to slug cancelling belt.
2. Meter slugs and SPR's go to weighing then to belt SPR-3(110).
3. Meter flats go to weighing then to flat sorting (060).
4. Nonmachinable letters go to portable canceller.

FLAT BELT (what to do)

1. Face stamped flats with vertical belt.
2. Leave letters on belt.
3. Cull all other types:
   (a) meter flats
(b) meter slugs
(c) airmail
(d) third class
(e) hand stamp

FLAT BELT (where to take things)
1. Metered flats go to weighing, then to flat sorting (060).
2. Metered slugs go to weighing, then to belt SPR-3 (110).
3. Stamped letters go to belt CC-4.

REJECT BELT (what to do)
1. Tray machinable meter letters.
2. Tray nonmachinable stamped letters and letter-size slugs.
3. Tray nonmachinable meter letters.
4. Leave loose, machinable stamped letters on belt.
5. Cull all other types into carts:
   (a) stamped flats
   (b) meter flats
   (c) stamped slugs and SPR's
   (d) meter slugs and SPR's
   (e) third class mail
   (f) bundled meter letters
   (g) hand stamp
   (h) air mail (into tray)

REJECT BELT (where things go)
1. Machinable stamped letters go to feed hoppers for #2, 3, 4.
2. Nonmachinable stamped letters and letter-size slugs go to portable canceller.
3. Machinable meter letters go to LSM sorting (080).


5. Stamped flats go to flat cancellation on belt FL-3.

6. Meter flats go to weighing then to flat sorting (060).

7. Stamped slugs and SPR's go to slug cancelling belt.

8. Meter slugs and SPR's go to weighing then to belt SPR-3.

**BUNDLED LETTERS BELT (what to do)**

1. Break all letter bundles.

2. Tray meter letters, put trays on skate wheel conveyor.

3. Leave stamped letters on belt.

**BUNDLED LETTERS BELT (where things go)**

1. Full trays of meter letters go to weighing then to LSM sorting (080).

2. Stamped letters go to belt AFC-I feed hopper.

**SLUG & SPR CANCELLATION (what to do)**

1. Cancel all stamped pieces by roller.

2. Separate pieces:
   
   (a) third class

   (b) stamped and meter slugs and SPR's

   (c) stamped and meter flats

   (d) airmail

**SLUG & SPR CANCELLATION BELT (where things taken)**

1. Slugs and SPR's go to weighing then to belt SPR-3 (110).

2. Flats go to flat sorting (060).
# Appenidix E-1

## Workday Classification and Weighting

<table>
<thead>
<tr>
<th>Code</th>
<th>Type of Day</th>
<th>Number per year</th>
<th>Number in Sample</th>
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<tbody>
<tr>
<td>A</td>
<td>Day after holiday</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>B</td>
<td>First day of week</td>
<td>53</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>Last day of week</td>
<td>52</td>
<td>8</td>
</tr>
<tr>
<td>D</td>
<td>First day of month</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>E</td>
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<td>12</td>
<td>5</td>
</tr>
<tr>
<td>F</td>
<td>Christmas rush</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>G</td>
<td>Other</td>
<td>104</td>
<td>9</td>
</tr>
<tr>
<td>H</td>
<td>Weekends</td>
<td>104</td>
<td>5</td>
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</table>

**Totals**: 370* 53

*Overlap among categories was allowed in some cases.*
## APPENDIX E-2

### PIECES PROCESSED PER DAY (000's)

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<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>Wt. Ave.</th>
<th>Vol. %</th>
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<tr>
<td>010 Letter</td>
<td>725.3</td>
<td>779.8</td>
<td>676.9</td>
<td>871.1</td>
<td>806.1</td>
<td>1172.8</td>
<td>685.2</td>
<td>313.7</td>
<td>635.6</td>
<td>51.3</td>
</tr>
<tr>
<td>010 Flat</td>
<td>6.9</td>
<td>6.5</td>
<td>13.9</td>
<td>10.2</td>
<td>10.5</td>
<td>14.5</td>
<td>12.6</td>
<td>9.3</td>
<td>10.8</td>
<td>0.9</td>
</tr>
<tr>
<td>010 SPR</td>
<td>3.0</td>
<td>2.7</td>
<td>5.1</td>
<td>4.0</td>
<td>3.2</td>
<td>6.7</td>
<td>5.3</td>
<td>2.4</td>
<td>4.0</td>
<td>0.3</td>
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<tr>
<td>010 Total</td>
<td>735.2</td>
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<td>695.9</td>
<td>885.3</td>
<td>819.8</td>
<td>1194.0</td>
<td>703.1</td>
<td>325.4</td>
<td>650.5</td>
<td>52.5</td>
</tr>
<tr>
<td>020 Letter</td>
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<td>539.1</td>
<td>615.6</td>
<td>665.1</td>
<td>671.8</td>
<td>677.7</td>
<td>698.5</td>
<td>82.9</td>
<td>483.0</td>
<td>38.9</td>
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<tr>
<td>020 Flat</td>
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<td>93.6</td>
<td>94.7</td>
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<td>66.6</td>
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<td>53.8</td>
<td>10.7</td>
<td>40.1</td>
<td>3.2</td>
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<td>020 Total</td>
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<td>649.5</td>
<td>772.5</td>
<td>806.4</td>
<td>815.5</td>
<td>811.3</td>
<td>845.9</td>
<td>108.6</td>
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<td>47.5</td>
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<td>010,020 Total</td>
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<td>1438.5</td>
<td>1468.5</td>
<td>1691.8</td>
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<td>2005.3</td>
<td>1549.0</td>
<td>434.0</td>
<td>1240.1</td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX E-3

**MAN-HOURS PER DAY**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>Wt. Ave.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>010 Clerks</strong></td>
<td>241.6</td>
<td>185.7</td>
<td>261.9</td>
<td>267.6</td>
<td>255.0</td>
<td>385.0</td>
<td>298.1</td>
<td>69.3</td>
<td>214.4</td>
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<tr>
<td><strong>010 M/H, P/A</strong></td>
<td>267.4</td>
<td>242.4</td>
<td>321.4</td>
<td>307.1</td>
<td>311.8</td>
<td>360.0</td>
<td>348.2</td>
<td>164.4</td>
<td>273.9</td>
</tr>
<tr>
<td><strong>010 Total</strong></td>
<td>509.0</td>
<td>428.1</td>
<td>583.3</td>
<td>574.7</td>
<td>566.8</td>
<td>745.0</td>
<td>646.3</td>
<td>233.7</td>
<td>488.3</td>
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<tr>
<td><strong>020 Clerks</strong></td>
<td>13.3</td>
<td>14.1</td>
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<td>13.6</td>
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<td>30.3</td>
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<td><strong>020 M/H, P/A</strong></td>
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<td>24.9</td>
<td>49.6</td>
<td>35.7</td>
<td>40.2</td>
<td>39.6</td>
<td>51.7</td>
<td>6.7</td>
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<td><strong>020 Total</strong></td>
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<td>54.3</td>
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<td>620.6</td>
<td>805.6</td>
<td>728.3</td>
<td>242.4</td>
<td>539.1</td>
</tr>
</tbody>
</table>
APPENDIX F

GRADUATE RESEARCH ASSISTANTS PARTICIPATING IN THE STUDY

The following Graduate Research Assistants from the School of Industrial and Systems Engineering participated in the project and made significant contributions toward its completion:

Khosrow Behbehani
Thomas H. Campbell
Charles L. Carroll
Joseph R. Donatiello
Robert A. Holmes
David E. Mitchell
Soheil Rezai
Richard C. Rothwell
Robert M. Semmes
Ahis D. Sherali
Stephen P. Stuk
Carl S. Wilburn