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Short-term Improvements for SEPTA's Regional Rail System

Vukan R. Vuchic

University of Pennsylvania, vuchic@seas.upenn.edu

Shinya Kikuchi

University of Delaware

Eric C. Bruun

University of Pennsylvania

Partha Chakroborty


University of Delaware

Yong Shin Eun

University of Pennsylvania

See next page for additional authors

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Short-term Improvements for SEPTA's Regional Rail System

Abstract

SEPTA has made significant improvements on its Regional Rail System since its takeover from Conrail some 10 years ago. This system now offers highly reliable service; stations are clean, many have obtained improved platforms, signs and other equipment; Trailpasses are used extensively. Yet, the ridership is low relative to the excellent coverage the network provides, and it has had a predominantly declining trend. Moreover, financial results are unsatisfactory: the Regional Rail Division's operating ratio is considerably lower than the other SEPTA divisions' ratios. There is a serious danger that the system will continue along a "spiral" of increasing fares and/or service cuts - decreasing ridership - reduced revenues - further fare increases and/or service cuts.

The reasons for this upsetting trend are many. At the time of system's takeover, SEPTA discontinued many atavistic railroad practices, such as paying an extra day's wage when the crew uncouples cars for the second time in one day, heavy payments for any extra work of the crew (bringing a seat into the car, etc.). Yet, the basic problem is that the system still has an inherently obsolete "structure" as well as many operating practices of old-fashioned "commuter railroads": very slow station boarding due to low platforms and poor car design, obsolete manual fare collection, highly labor-intensive operation and the resulting long headways, restrictive FRA rules, etc. All of these factors make the service less competitive with the private automobile, as well as inefficient in operation.

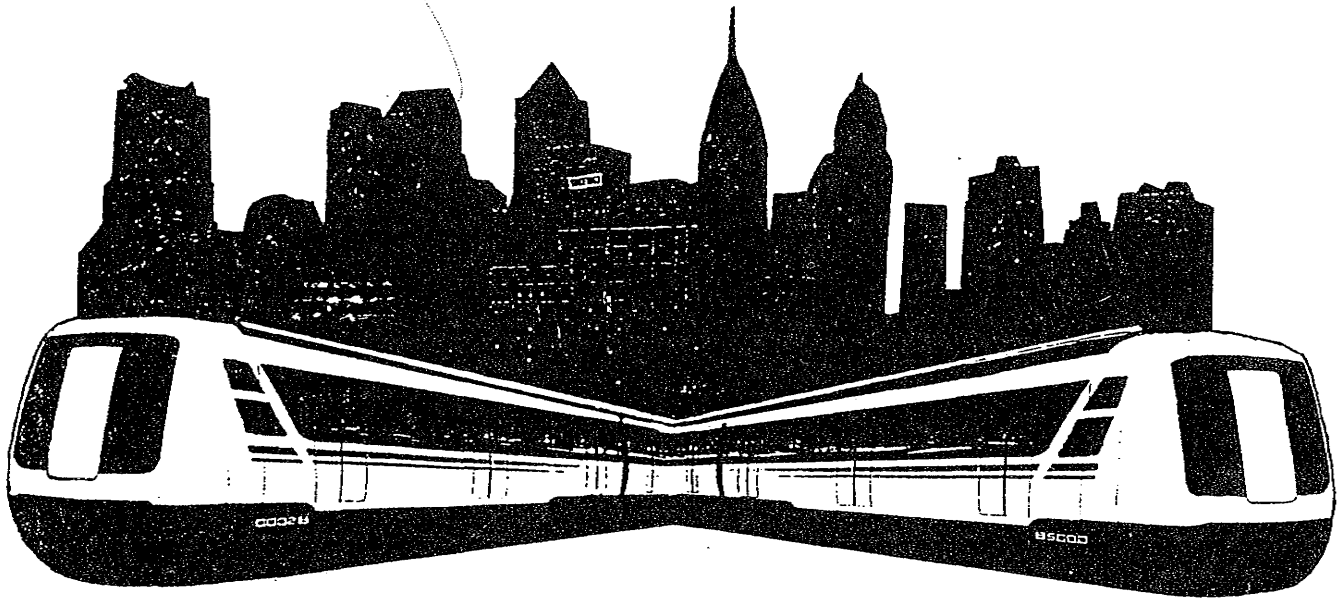
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Author(s)

Vukan R. Vuchic, Shinya Kikuchi, Eric C. Bruun, Partha Chakroborty, Yong Shin Eun, Janaki Parameswaran, Nikola Krstanoski, and Natasa Vukadinovic



Short-term Improvements for SEPTA's Regional Rail System

Report to



Southeastern Pennsylvania Transportation Authority

By

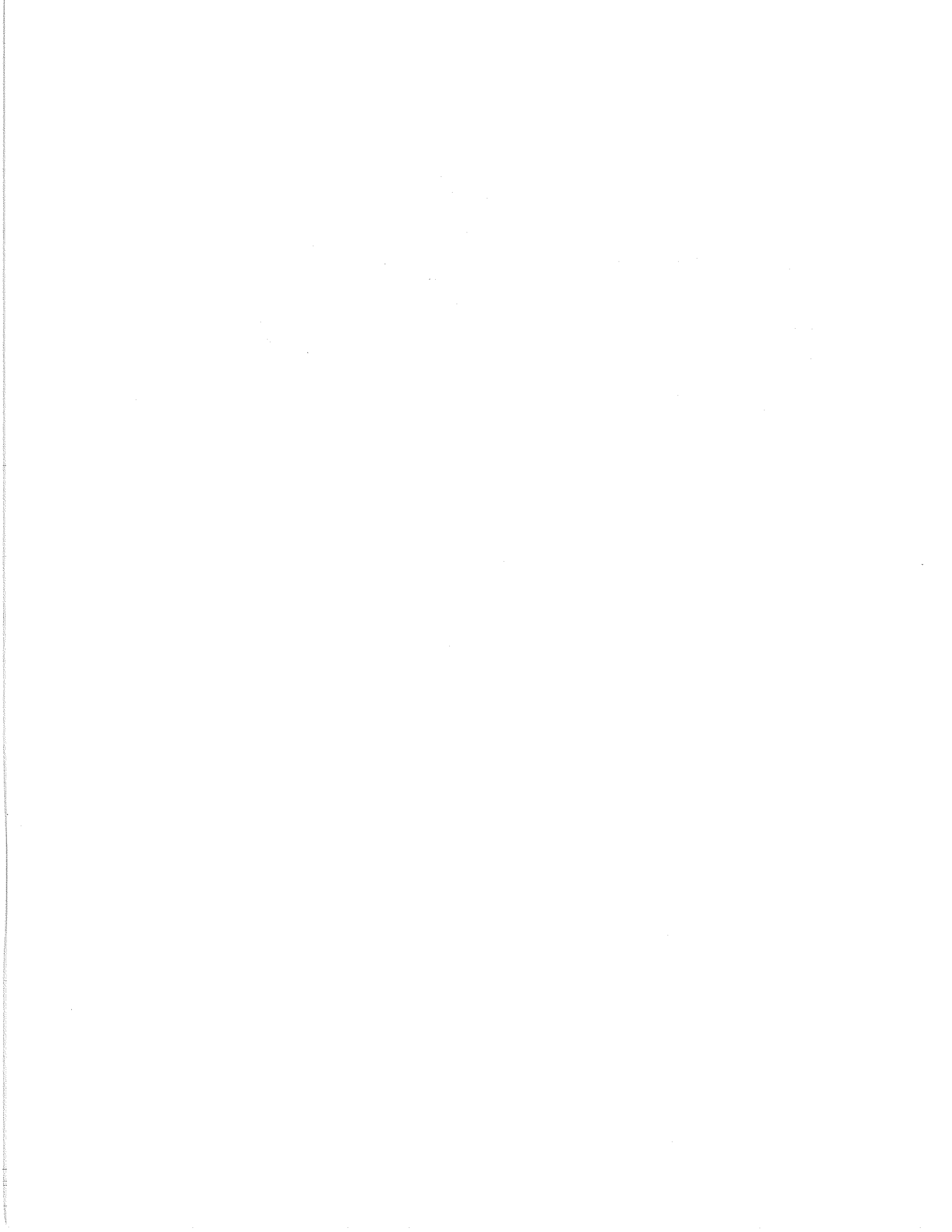


University of Pennsylvania



University of Delaware

Philadelphia
August 1994



Short-term Improvements for SEPTA's Regional Rail System

Report for the
Southeastern Pennsylvania Transportation Authority

SEPTA

Prepared by:

Prof. Vukan R. Vuchic, Ph. D.
Principal Investigator
Eric C. Bruun, Ph. D.
Yong Eun Shin
Nikola Krstanoski
Research Fellows
Department of Systems Engineering
University of Pennsylvania

Prof. Shinya Kikuchi, Ph. D.
Co-Principal Investigator
Partha Chakroborty
Janaki Parameswaran
Natasa Vukadinovic
Research Fellows
Department of Civil Engineering
University of Delaware

Philadelphia
August 1994

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Executive Summary

SHORT-TERM IMPROVEMENTS FOR SEPTA'S REGIONAL RAIL SYSTEM

SEPTA has made significant improvements on its Regional Rail System since its takeover from Conrail some 10 years ago. This system now offers highly reliable service; stations are clean, many have obtained improved platforms, signs and other equipment; Trailpasses are used extensively. Yet, the ridership is low relative to the excellent coverage the network provides, and it has had a predominantly declining trend. Moreover, financial results are unsatisfactory: the Regional Rail Division's operating ratio is considerably lower than the other SEPTA divisions' ratios. There is a serious danger that the system will continue along a "spiral" of increasing fares and/or service cuts - decreasing ridership - reduced revenues - further fare increases and/or service cuts.

The reasons for this upsetting trend are many. At the time of system's takeover, SEPTA discontinued many atavistic railroad practices, such as paying an extra day's wage when the crew uncouples cars for the second time in one day, heavy payments for any extra work of the crew (bringing a seat into the car, etc.). Yet, the basic problem is that the system still has an inherently obsolete "structure" as well as many operating practices of old-fashioned "commuter railroads": very slow station boarding due to low platforms and poor car design, obsolete manual fare collection, highly labor-intensive operation and the resulting long headways, restrictive FRA rules, etc. All of these factors make the service less competitive with the private automobile, as well as inefficient in operation.

A plan for permanent upgrading of the Regional Rail System, entitled "**A Plan for SEPTA's Metrorail System**" was presented by this team to SEPTA in May 1993. There are, however, a number of non-capital modernizations and improvements which can be introduced in the short term, and which would have a significant impact on stopping, possibly reversing, the above-mentioned "downward spiral" of the Regional Rail System. A number of such improvements are presented and explained in this report.

Following the **definition of present problems and proposed goals** for system's short-term improvements in Chapter 1, several **analyses of the present schedules** are presented in Chapter 2.

A possibility of operating the 30th Street-Jenkintown **trunk with regular short headways and some branches** (such as Chestnut Hill East, Fox Chase and Warminster) - as **independent shuttles** has been investigated. The results show that **this type of operation would not be practical**, mostly because designs of stations and track layouts do not allow easy, convenient passenger transfers and train maneuvers.

Another analysis focused on the **present R-3 peak hour schedules**. Due to the zonal services, which reduce travel time from some stations by a few minutes, many stations on this line have irregular and very long headways (up to 37 minutes) even during the peaks. It is proposed to introduce a **6-month test with greatly simplified all-local service with regular headways at all stations**. If this service attracts higher ridership (which is quite probable), it should be retained. The new schedule would not involve any major changes in train-hours of operation. **It is essential that the increased service frequency be properly advertized.**

Although many of the recommended changes are not ready for immediate implementation (they must be checked against other constraints, such as the availability of "slots" on Amtrak lines), a methodology is presented which can be used on any schedule to examine its provisions for interline transfers.

There are presently **very few transfers among different Regional Rail lines**, such as travel from Fox Chase to Torresdale or Wilmington to Bryn Mawr. One of the reasons is that the schedules of different lines are not coordinated for that purpose, so that many times transfers may involve waits of 30-50 minutes at 30th Street Station or Market East Station. A detailed analysis of transfer possibilities has shown that the present schedules can be adjusted to improve attractiveness of transferring among lines and thus attract some of the latent, presently untapped potential ridership. The major focus of these transfers has been the R-1 and R-7 lines, which have the greatest need for better transfers with most other lines.

Transferring among the lines is also impeded by incomplete information about such possibilities. While the pamphlet "**SEPTA's Guide to Regional Rail Travel**" is very helpful

for passenger orientation about the entire Regional Rail System, recently published schedules for individual lines do not have information about fares for travel through Center City. On some schedules it is not even indicated where the trains continue beyond Center City. This must be corrected in order to facilitate, rather than prevent, transfers among lines and travel through Center City. All train schedules must show at least both terminals that they serve as well as complete fare information.

Quality of service and facilities has been the focus of Chapter 3. The most important recommendations are that the **deplorable conditions of the 30th Street Station be acted upon immediately**, and that the **problem of trash and sloppy condition of many trains be improved**. SEPTA's Regional Rail remains one of the last US transit systems that allows **eating and drinking, where crews do nothing to discourage leaving all kinds of trash, nor does it collect any of the "clean" trash, such as newspapers**. If that is prevented by labor rules, it is time to change such obsolete rules.

Chapter 4 analyzes a number of potential operational improvements. In spite of numerous innovations and changes in fare types and methods of collection, the Regional Rail System still has the highly obsolete and inefficient method of fully manual fare collection and control. Although the plan for a complete self-service fare collection (SSFC) system is included in the long-term plan, **there is no reason that SEPTA can not introduce on-train ticket-selling and ticket-canceling machines which would allow introduction of partial or full SSFC**. The claims that this "cannot be done" on an "open" system without gate controls like Regional Rail has been disproved by a dozen light rail systems (San Diego, Buffalo, Portland, Sacramento and others) which have SSFC under very similar conditions. Even a partial SSFC would allow reduction of some train crew sizes and thus either cost savings or increased service frequency.

A well-planned effort to **attract more intra-suburban travel** is recommended. Also, there should be an effort to **increase ridership at close-in stations** through reduced fares, improved service and information. Stations at which this would not increase usage, should then be considered for closing.

A number of recommendations are made for **improved station operations** (boarding/alighting and dispatching of trains): opening of all doors, speeding up

boarding/alighting, particularly when some delays have already occurred, more active role of the crew members, etc.

In spite of the major efforts of the top SEPTA managers to make the system "passenger friendly", the **Regional Rail System remains extremely deficient in its treatment of present and potential passengers.** With the exception of the Airport (R-1) Line, trains generally have inadequate signing, there is no way for passengers at stations to find the causes or lengths of delays, etc. **Implementation of the conclusions of the conference on passenger-friendly services organized by SEPTA in October 1989 is recommended.**

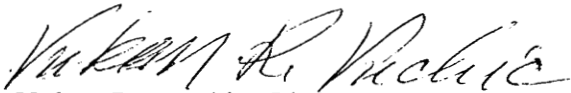
Marketing of the system is also inadequate, in many ways non-existent, and a number of recommendations are given for at least a minimum marketing of services which would most likely be cost-effective. It is pointed out that the **Airport Line and the Trenton-New York connection are particularly underutilized because of total absence of information and marketing.** For example, visitors to the city are told at the Airport by a single conspicuous sign that there are "Trains to Center City". They are not told that those trains can take them **conveniently, reliably and economically to some 164 points throughout five counties and three states!** Nor does anybody hear the fact that from Trenton it is cheaper, more convenient and usually faster to get to the Philadelphia International Airport than to Newark Airport.

Similarly, there is **major untapped potential for significant passenger increases on the Trenton (R-7) Line-NJT connection to New York City and other stations along the Corridor.** Recommendation 4.27 presents a series of very specific actions for improving the Trenton-New York service. These actions would require a very small investment, but would result in very significant ridership and revenue increases for SEPTA and NJT.

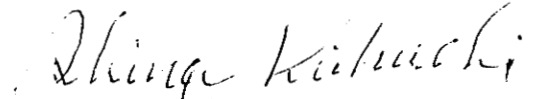
During this project SEPTA has upgraded speeds and increased frequencies of **Sunday services on several lines.** These changes have already resulted in ridership increases. Similar improvements are under way or being planned for additional lines. These are important improvements which will make the system more attractive and more economical to operate.

It is strongly suggested that the recommendations from this report, which are clearly highlighted throughout the text, be considered for implementation in the immediate future.

They do not require capital expenditures, but they have considerable potential for stopping and reversing the "downward spiral" in which the Regional Rail System has been in recent years.



Vukan R. Vuchic, Ph.D.
University of Pennsylvania



Shinya Kikuchi, Ph.D.
University of Delaware

Philadelphia
August 1994

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Chapter 1

INTRODUCTION

The University of Pennsylvania and the University of Delaware have carried out a detailed study of the SEPTA Regional Rail System. This study resulted in a comprehensive plan for a medium- and long-range upgrading and development of the system, which is reported in a separate volume. The present report contains the results of a closely related study of short-term low-investment improvements of the Regional Rail System.

The two studies, for short- and for long-range improvements, are complementary. Some elements, such as different phases of fare collection changes, have a certain overlap between the two studies. Although some solutions include alternatives (such as purchase and canceling of tickets in stations vs. on board trains), every effort has been made to prepare short-range improvements which could lead to long-range upgrading without duplication or inconsistent changes in equipment, facilities and operations.

This report starts with a definition of the present Regional Rail System deficiencies and problems, followed by a statement of the basic goals for short-term improvements. In Chapter 2 several possible improvements in operations and scheduling are analyzed. Chapter 3 presents suggested improvements in the quality of facilities. Various general as well as very specific suggestions for improved utilization of services through changes in fares, in schedules and operations, improved user friendliness and marketing are given in Chapter 4.

1.1 Present System Strengths and Problems

SEPTA's Regional Rail System has several features which make it one of the leading regional transit systems in the country. Its network, shown in Fig. 1.1, is very extensive, consisting of seven diametrical lines and 290 km (180 miles) of length. It serves an area with population exceeding three million. Its services are integrated to a considerable extent with the regular transit in the region.

The provided services are generally reliable, they have a reasonably high speed, nearly all passengers are seated, and image of service quality has been improved in recent years. Yet,

ridership volume of about 80,000-90,000 trips per weekday is far lower than the riderships found on similar networks in most peer cities in North America and elsewhere. A critical evaluation of service elements which may have a negative impact on passenger attraction is therefore in order.

An extensive analysis of the services and a review of public comments point out the following major deficiencies in the Regional Rail service from the users' point of view:

1. Long headways, which make the use of Regional Rail services during off-peak hours quite inconvenient. Even during the peak hours headways at some well-utilized stations are as long as 30 to 50 minutes. That is not an attractive transit service.
2. High fares, relative to cheaper transit alternatives in close suburban areas and to auto driving (which is often subsidized by tax deductions, free parking, etc.).
3. Inadequate information: for many potential users it takes a special effort to obtain information about the Regional Rail services, their schedules, fares, etc. Recent inconsistent changes and duplications of line designations (e.g., R-1 and R-2), as well as separation of most line schedules into two sections have increased the confusion and diminished the image of the Regional Rail System as an integrated network. Many stations, particularly the most important ones in City Center, are very poorly marked.
4. Virtually non-existent marketing of services, often making attraction of users to the System extremely difficult.
5. Inconvenient transfers to some other services, such as to various suburban bus routes and to regular transit at Center City stations (e.g., 30th Street Station), as well as among the Regional Rail lines. Many transfers are indirect, long and without adequate information. Also, cash fares do not permit transfers between Regional Rail and other Divisions.
6. Unsatisfactory scheduled speeds: although train speeds on the lines are reasonably high, they are lower than the speeds offered some 20-30 years ago. With the improvements to the freeway system in the region, such speeds have become less and less competitive. The decrease in scheduled speeds has occurred due to conservative driving patterns and excessive "cushion times". Excessive scheduled times in the core section, 30th Street to Market East Stations, are particularly damaging because they affect all lines and the largest volumes of passengers.

7. Car cleanliness is often unsatisfactory.

Some major deficiencies can also be identified with respect to operating efficiency, such as: (a) High labor costs; (b) Obsolete fare collection method; (c) Excessively restrictive FRA rules; some of these originate from long-distance freight operations and they are poorly suited to regional transit-type operations; (d) Some resistance to changes in operations within the organization. These present difficulties in the process of System modernization - a process which has been under way since SEPTA's takeover, but at a slow pace.

1.2 Suggested Short-Term Goals

Major goals in short-term improvements of the Regional Rail services can be briefly stated as follows:

1. Reverse the general trend of decreasing ridership in recent years. The recent recovery of passengers after the Railworks Project should be sustained and extended to the entire network. Achieve significant ridership gains through operational innovations and service improvements.
2. Increase service efficiency: decrease operating costs to enable introduction of better services without increases in operating costs.

The analyses and recommended improvements presented in the following chapters are aimed at achieving of these two goals through a set of coordinated measures.

Chapter 2

OPERATIONS AND SCHEDULING IMPROVEMENTS

Construction of the Center City Tunnel has successfully achieved transformation of the original commuter rail system into a modern regional rail system. The initial system consisted of two sets of radial lines. Since the two sets were not connected, there was practically no possibility to serve any travel except that to and from the CBD. The new integrated network, schematically shown in Figures 2.1 and 2.2, offers opportunities for travel among many points throughout the region with convenient transfers. In addition, passengers from the Ex-Penn Central network have obtained one additional station in the CBD, while the Ex-Reading passengers now have two more CBD destinations without transfers.

In a brief overview, the Regional Rail System compared to the former predominantly commuter rail system has the following advantages (+) and disadvantages (-):

- + The integrated network offers true regional many-to-many points services;
- + Through services result in more direct travel and shorter travel times.
- + Connectivity of the regional rail with other transit service is greatly increased;
- + The long lines have higher roundtrip speeds due to the lower terminal time losses, maneuvering and safety check requirements; this decreases operating costs per car- and train-hour;
- + Presence of an integrated regional rail network has a much stronger image and thus attracts more riders than the conventional radial commuter rail service did;
- Delays on one section of a through line can cause delays and irregular services on the other section;
- In some cases (when capacities of the two sections are not matching) through lines result in additional car-kms (-miles) and thus increased operating costs.

In conclusion, the present unified network offers a much higher quality of Regional Rail service than individual radial lines could have ever achieved. The change involved some operating economies (increased roundtrip speeds), but also some operating cost increases (added

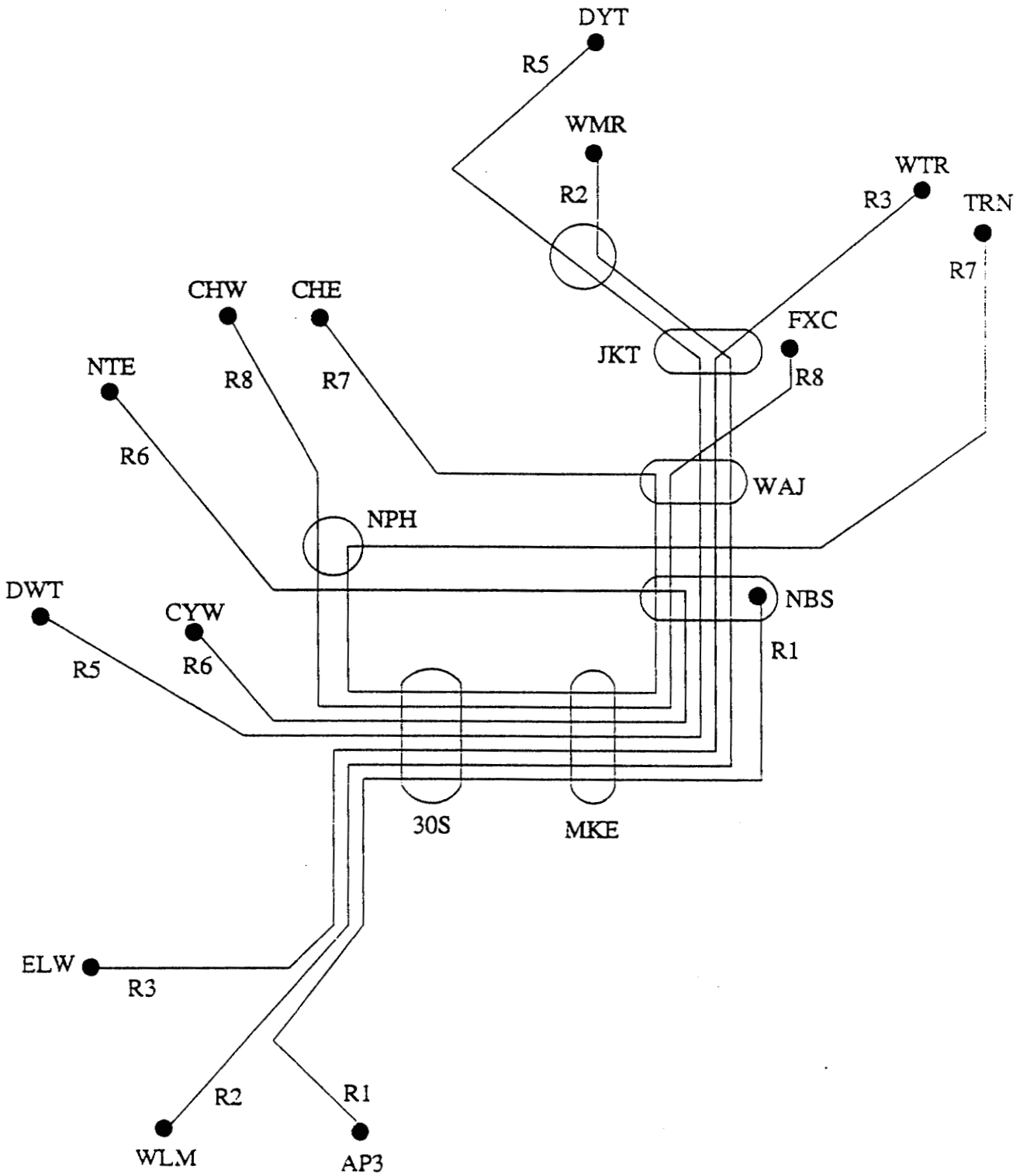


Figure 2.1 Schematic diagram of the Regional Rail network

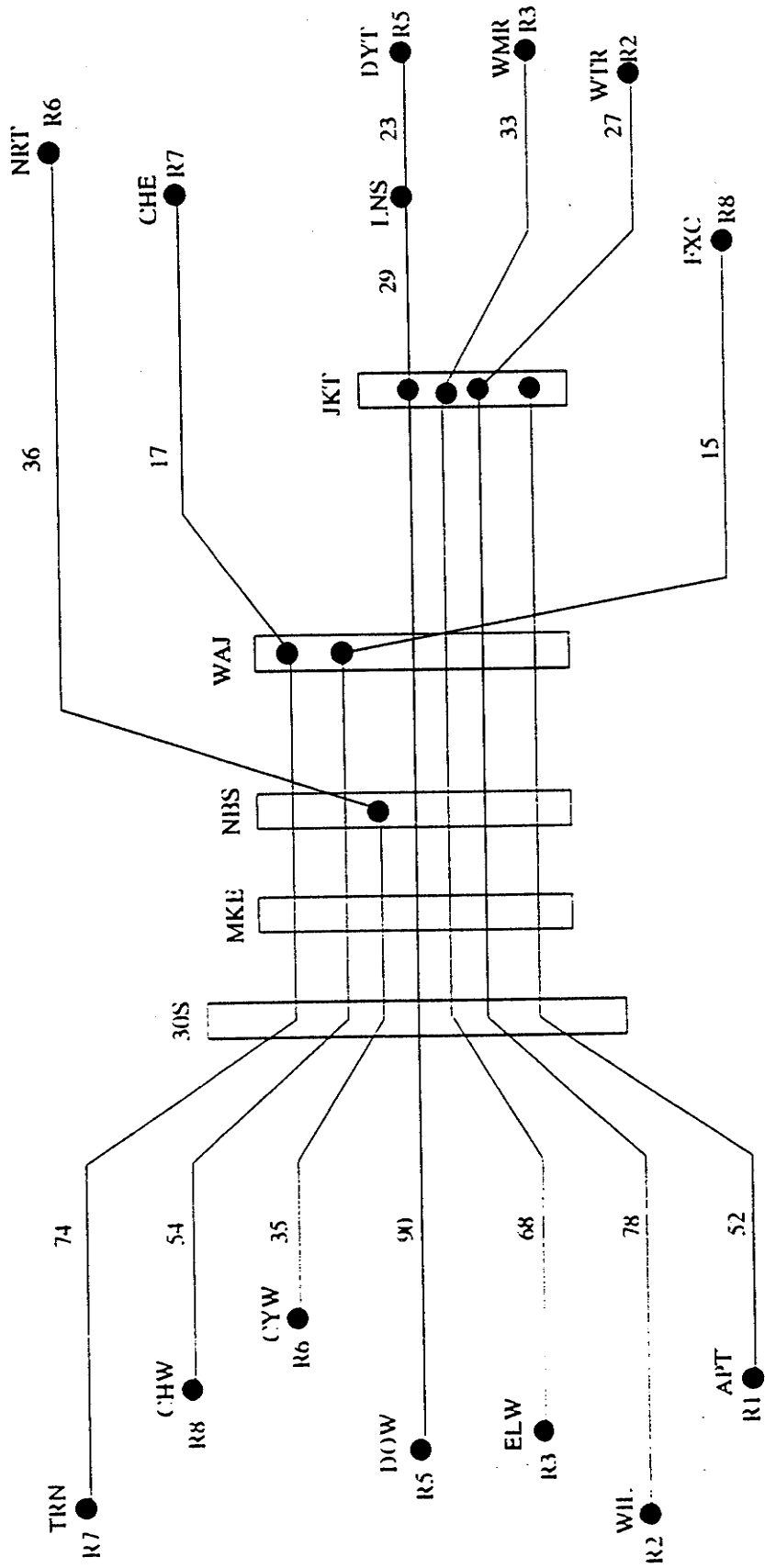


Figure 2.2 Schematic of trunk and branches with travel times

car-kms of operation).

In the past there have been suggestions that the present pattern of lines should be replaced by independent radial lines, i.e., that the operating pattern should be returned to the commuter network that once existed. This proposal should not be taken seriously because its advantages of simpler scheduling and higher service reliability would be greatly outweighed by the numerous negative effects, such as losses of through passengers, weakened image, creation of operational problems due to much higher train frequencies on the trunk section, increased passenger- and car-miles (km) and car-hours, etc. Actually, it is obvious that if the network was operated as a set of independent radial lines, it would be quite logical to improve that system by reverting it to the present set of diametrical lines.

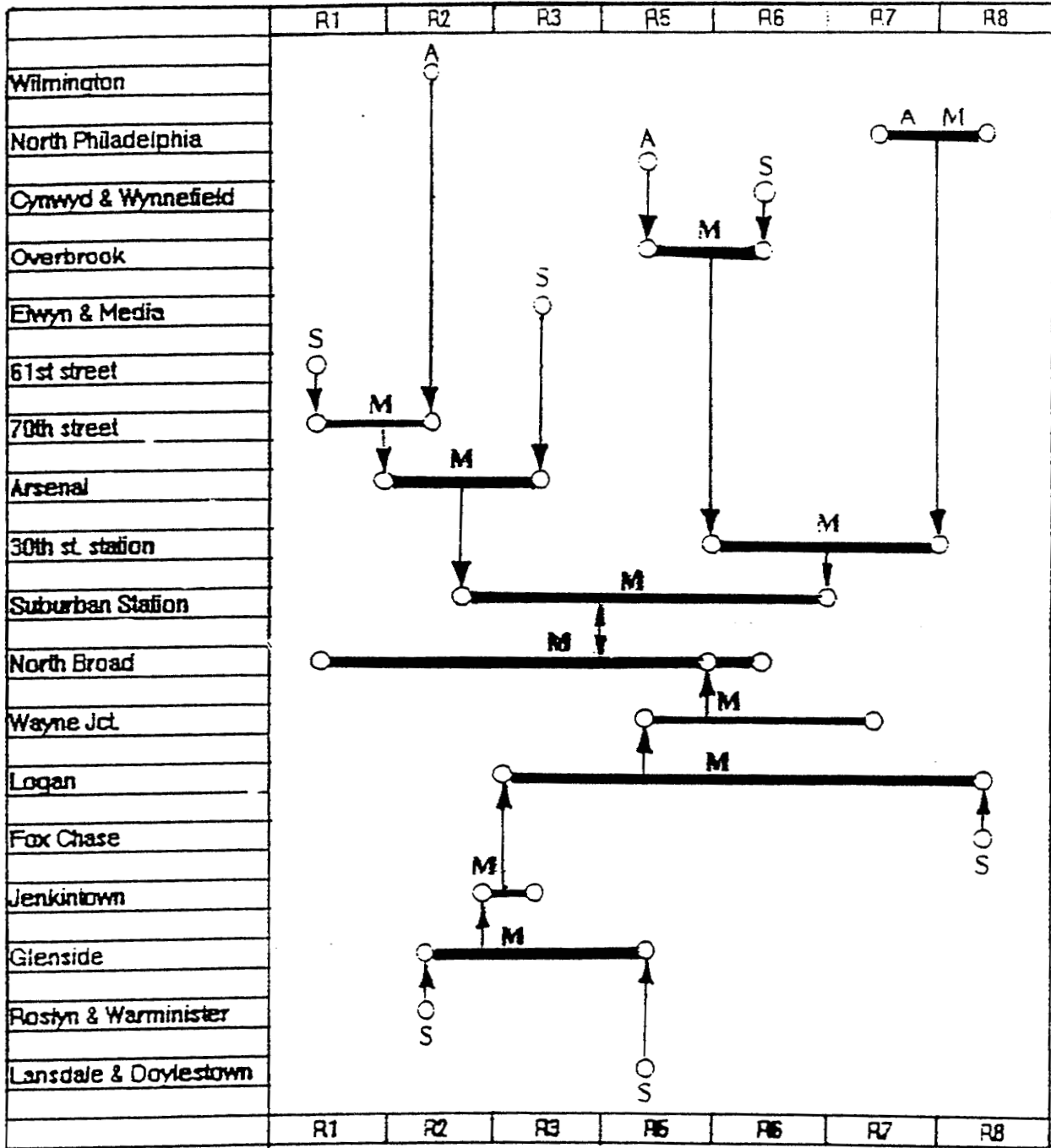
To examine possible further improvements of the present services, a number of different new operating concepts and service changes have been examined; they are described and evaluated here. An analysis is made of the relationship between the service on the trunk section (30th Street Station to Jenkintown) and branches (all lines from their separation from the trunk to their outlying terminals). Different schedule coordination methods to improve the most important transfers (to and from the Airport and Trenton/New York) are then proposed. Finally, an analysis of possible improvements to the R-3 service is presented.

2.1 Network Scheduling Concepts

The Regional Rail network can be considered as consisting of a trunk section and a number of branch lines. The network west of the 30th Street Station divides immediately (prior to the first stations on any one line) into seven branch lines, so that there is practically no trunk section. East and north of the 30th Street Station, three lines (R-6, R-7 and R-8) branch out at different points, while the remaining four (R-1, R-2, R-3 and R-5) continue and form a trunk section to Jenkintown, where they branch out into two and eventually, at Glenside, another two branches.

A sketch of the network layout, showing all potential operational constraints (merging points, single-track sections, use of Amtrak tracks), is shown in Figure 2.3.

Presently separate lines operate independently over individual branches and run jointly along the trunk. Three other types of line formation and scheduling are possible, and these



M - Merge
 S - Single track
 A - Amtrak track

Figure 2.3 Constraint points in the Regional Rail Network

alternatives should be examined, particularly for off-peak hour operations. Therefore, the following four operating plans are described and evaluated here:

- I. Separate lines with independent schedules (the present system);
- II. Separate lines with regular joint schedule on the trunk;
- III. Regular schedule on the trunk with independent feeders on the branches;
- IV. Schedule providing coordinated transfers among lines.

2.1.1 Pattern I: Separate Lines with Independent Schedules

This type of operation consists of schedules developed for each individual line and involves little interdependence and schedule coordination among the lines in the network. It is designed to be convenient for travel on each line, but transferring times among the lines are random. The headways on the trunk line are irregular.

This pattern is used presently, with some modification to achieve somewhat regular headways on the trunk section.

2.1.2 Pattern II: Separate Lines with Regular Joint Schedule on the Trunk

This operation involves such scheduling of individual lines that they offer regular headways on the trunk section. The advantages of this type of scheduling would be more reliable and attractive service due to regular headways on the trunk section, similar to rapid transit service.

Implementation of this type of schedule is difficult because of many constraints on different lines, such as the limitations on time slots on Amtrak tracks (R-2, R-5 and R-7), and single track operations on several branches (R-2, R-5 and R-6), as illustrated by Figure 2.3. Yet, in spite of these constraints, SEPTA has in recent years improved regularity on the trunk as compared to the previously used schedules; the proposed changes should be the logical next step in scheduling improvements.

2.1.3 Pattern III: Regular Trunk Service with Independent Feeders

This operating concept would consist of regular and frequent service on the trunk and several independent shuttle-feeders on the branches east/north from the Center City stations.

Similar to the preceding concept, this operation has some merit for off-peak services, and it has been examined in considerable detail.

Generally, operation of a network as a trunk with short and regular headways (not exceeding 10 min.) and independent feeders serving individual branches would reduce duplication of services on the trunk and thus decrease train- and car-km (miles) of travel. Another possible advantage might be achieved if cycle times on short branches are so short that a "shuttle" train on them can operate at shorter headways than the single through line can offer. Moreover, the trunk becomes somewhat more "immune" to the delays which may occur on individual branches.

The trunk-feeder operation also has significant disadvantages, however. First, it interrupts the ride and requires passengers to transfer. Second, it introduces additional maneuvering of trains, involves new brake tests and terminal times, and requires track layout that allows convenient handling of passenger transfers and train switching.

Extensive analyses of possible independent feeders on the Ex-Reading side, such as R-6 at North Broad Street, R-7 and R-8 at Wayne Junction and any of the R-2, R-3 or R-5 lines at Jenkintown, were made. They included examinations of schedules, particularly cycle times on the feeders, conditions for transfers at these stations, etc. The conclusion has been that the gains in service frequency and in reduced car-hours would not outweigh the major inconvenience of transfers and, at most terminals, difficult, time-consuming maneuvering of trains.

Consequently, the possibility of trunk-feeder operations under the present conditions (long headways, crews greater than one person, various FRA operating rules) has been eliminated from further considerations.

2.1.4 Pattern IV: Schedules with Coordinated Transfers

To fully utilize the extensive Regional Rail network for travel among all 163 stations, transfers among all lines must be greatly facilitated. Since all lines operate with rather long headways, particularly during off-peak hours, special attention must be given to coordination of schedules among different lines.

This section summarizes extensive analyses which have been performed to examine the possible changes in schedules which would increase the convenience of transfers.

IVa. Network-Wide Timed Transfer System: The concept of timed transfer operation can be used very effectively in bus and rail networks in which lines operate with long headways. Many transit systems use it during off-peak hours and on weekends, when headways of 30 and 60 min. are operated. Some major regional rail systems, such as the recently opened extensive S-Bahn (Regional Rail) System in Zurich, utilize timed transfers. Much of the Dutch National Railway System also operates utilizing timed transfers.

The schedules are made so that trains from different lines meet and exchange passengers during a 4-5 min. simultaneous station dwell time for all the lines meeting at transfer stations. These stations are then converted into or designated as "transit centers".

The main and very significant advantages of the timed transfer are that it provides virtually instantaneous and very convenient transfer among several lines. As a result, instead of independent lines, which often involve very inconvenient connections for transferring of passengers, the network becomes unified and offers more attractive services among all its stations.

There are several problems in introducing timed transfer on SEPTA's Regional Rail System. First, adequate station capacities (tracks and platform lengths) for all the trains that should converge simultaneously must be available. As can be seen in Figure 2.4, 30th Street Station is superior to the other two Center City stations in this respect: it has six through tracks, while Suburban Station and Market East have only four. Second, coordination of schedules on different lines is difficult because several of them are constrained by other conditions (Amtrak trains, single track sections, as shown in Figure 2.3).

Third, bringing the trains from all lines simultaneously to one station in some cases involves delays because some trains have to follow each other on the same track; this introduces headways of at least 2 min. between arriving and 2 min. between departing trains. Fourth, time has to be allowed for passengers to transfer between trains stopped ahead of each other on the same track, as well as between trains which stop at different platforms. The required longer station dwell time causes inconvenience to through passengers and increases train cycle times.

However, the concept of timed transfers has so many advantages, that several variations of it have been analyzed with very interesting results. These findings show several possibilities in scheduling for improved interline transfers. Moreover, they present a new methodology for

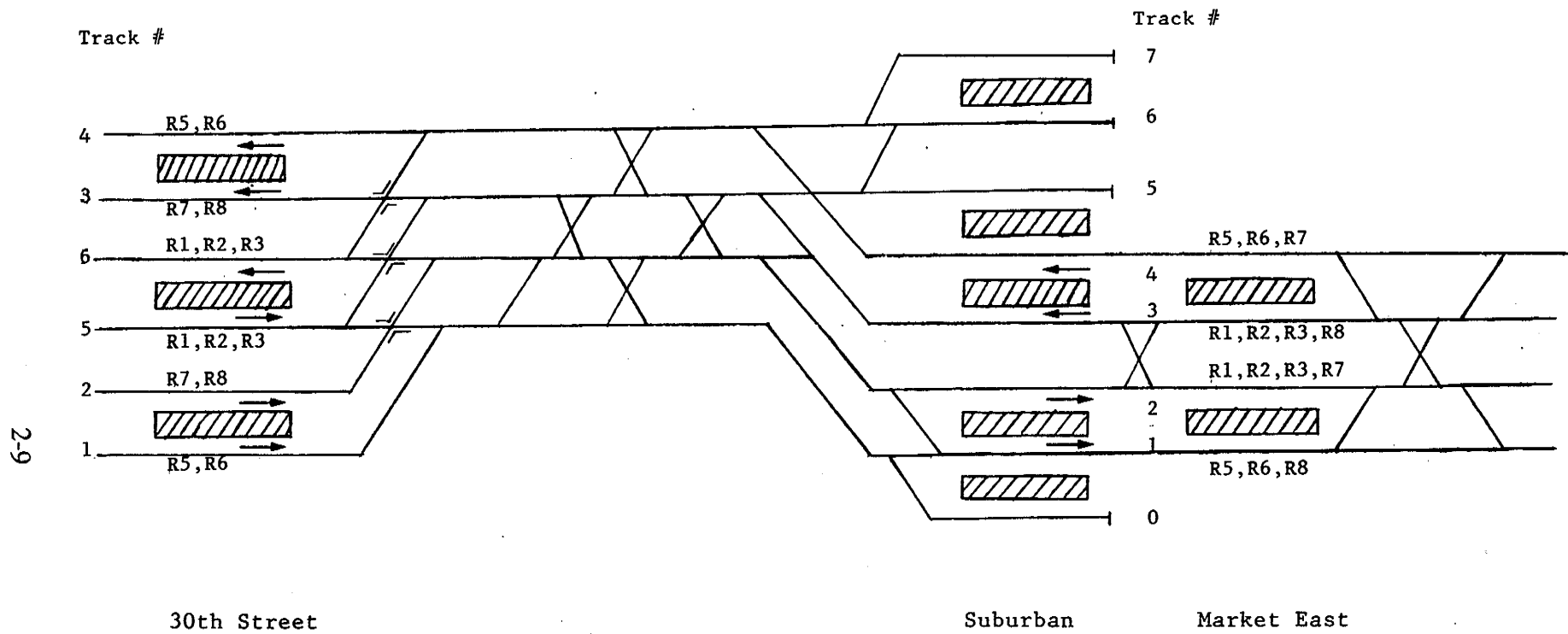


Figure 2.4 Center City track layout

testing any proposed schedule with respect to the transfer conditions.

Reliable services must be ensured, because they are essential for timed transfer operation; however, SEPTA's Regional Rail System now has sufficiently high reliability for this type of operation.

The timed transfer schedule on SEPTA's Regional Rail System would provide simultaneous meetings of trains from all, or nearly all the lines at one or all Center City stations (30th Street, Suburban and Market East). Among these three, 30th Street Station would be the logical point for timed transfer for two reasons. First, that is the only location which would not involve back-tracking of passengers coming from the west and proceeding to the west (reversing their direction). Second, with its 6 tracks and very long platforms, this station has capacity to accommodate the greatest number of trains, including possibly stopping of two or three trains on the same track.

Yet, in spite of the large track capacity, it would be physically impossible to have trains from all the lines meet simultaneously without excessive delays. The train meets have therefore been organized into two groups or "pulses".

Since most lines operate with hourly headways, but two (R-1 and R-5) have 30-min. headways, the pulses would be 30 min. apart. Each pulse would have the R-1 and R-5 trains, and trains from one half of the other lines.

The latter schedule, with two pulses, would involve less delay than if all trains (except every other R-1 and R-5 train) are brought together simultaneously. The reason is that there would be fewer trains to coordinate and bring to the same tracks; yet, a major problem with both of these schedules would be that they would delay the largest group of passengers in the network: those travelling from the ex-Pennsylvania lines to the Suburban and Market East Stations (and vice versa).

Due to this inconvenience to passengers travelling through 30th Street Station, and because of the considerable scheduling and operational problems, this system-wide timed transfer concept is not being recommended for implementation as a short-term improvement measure. Some elements of this concept, however, have been incorporated in further search for improved scheduling.

IVb. Improved Transfers for R-1 (Airport) Line: this schedule would provide for

convenient transfers between the R-1 trains arriving from and leaving for the Airport and all other lines.

One of the main reasons why the R-1 Line is greatly underutilized and captures a very small fraction of trips to/from the Airport is that it is presented to the public as a single line; its interconnections with all other lines are seldom even mentioned. The timed transfer schedule would not only increase the convenience of the interline transfers, but it would create a distinct image of the Airport Line as a key element in an integrated network.

IVc. Improved Transfers for R-7 (Trenton) Line: this is the same concept as the preceding one, but the focus would be on the R-7 line to/from Trenton (and New York), instead of R-1.

The R-7/NJT partially integrated service to/from New York City is another underutilized SEPTA's service. While this service is heavily used, it receives no special treatment by SEPTA in scheduling, information or marketing. All indications are that there is a major untapped market for this inexpensive service between two of the four largest metropolitan areas in the country.

Introduction of schedules which would provide more convenient transfers to/from R-7 at 30th Street Station would be a major factor in attracting a large portion of the presently latent demand for the Philadelphia-New York travel market.

IVd. Transfers Classified by Importance: For this schedule all individual branches are classified by relative importance. The most important transfers are those between R-1 and R-7 (Airport and Trenton, respectively) and all other lines. The second group are the lines with logical transfers, for example between R-5 west and R-8 east (Paoli to Fox Chase). The third, least important group, comprises the lines between which transfers are either not necessary (R-7 from the West to R-7 to the East - the same line), or which are not likely to be used (R-1 from the West to R-2 to the West, a "sharp U-turn" type of routing).

This classification of schedules has been utilized in the development of a recommended schedule. It utilizes elements from preceding schedules as much as is operationally feasible and desirable.

2.1.5 Recommended Schedule Pattern

Considering the above discussed requirements for regular (uniform) headways on the trunk, and coordinated transfers to and from R-1 and R-7 lines, a schedule has been developed which would meet these requirements better than the present schedule. The new schedule is not based on an exhaustive optimization methodology because of numerous diverse objectives and constraints; moreover, analysis of such constraints as Amtrak schedules was well beyond the scope of this project. However, the recommended schedule represents an improvement in transferring convenience among the lines, particularly for R-1 and R-7. This schedule is presented in four figures and one table.

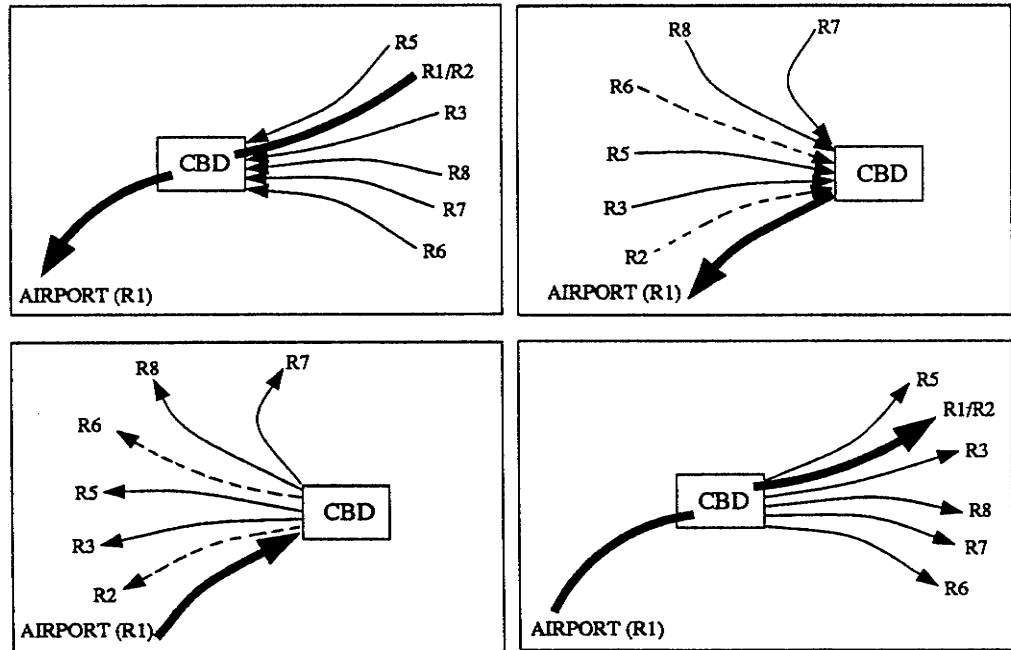
The transfers to and from R-1 and R-7 have been systematically analyzed. Figure 2.5 shows schematically all permutations of transfers from all lines to and from R-1 and R-7 lines; the groups of transfers are self-explanatory in the diagrams.

The radial sections of lines which have little or no need for this transfer are shown by dashed lines. These include the continuation of the same line (e.g., R-7 west, from Trenton, to R-7 east, toward Chestnut Hill East, requires no transfer); geometrically inconvenient movements, such as from the Airport to 30th Street Station, then reversing back to Wilmington; and, transfers to and from very weak lines, such as R-6, Bala Cynwyd.

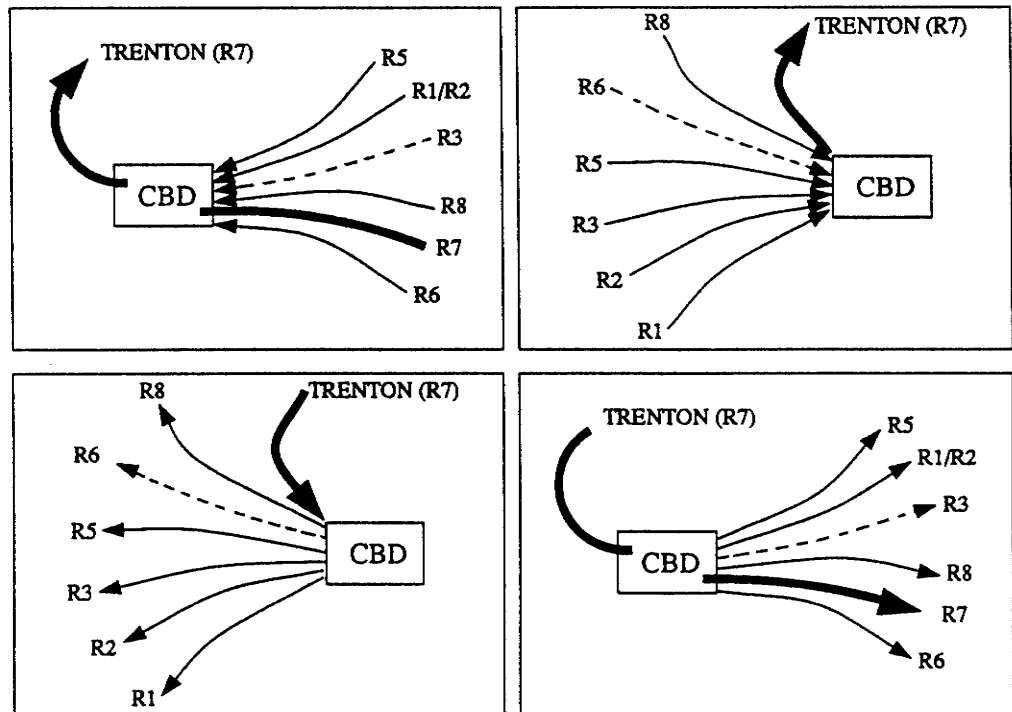
A graphical presentation of the existing scheduled train arrivals at 30th Street Station is shown using a clock-type diagram in Figure 2.6a. The figure shows that the arrivals of trains in both directions are quite irregular. While many headways are between 0 and 6 minutes, there are also headways as long as 15-min in each direction. Figure 2.6b presents the recommended schedule in the same manner. This diagram shows that uniform 10-min. headways are provided in each direction.

To facilitate understanding and compare transfer times under the present and recommended schedules, both schedules are shown as linear graphs in Figures 2.7a and 2.7b for R-1, and in Figures 2.8a and 2.8b for R-7. These figures follow the sequence of transfer diagrams in Figure 2.5, and they include the present and recommended schedules. On each graph the arrival or departure times of the line for which transfers are analyzed (R-1 (or R-7), westbound and eastbound) are plotted and used as the basic reference lines for transfers to/from the other lines. The heavy horizontal lines to those arrival or departure times of R-1 (or R-7)

Transfer combinations to/from Airport (R-1)

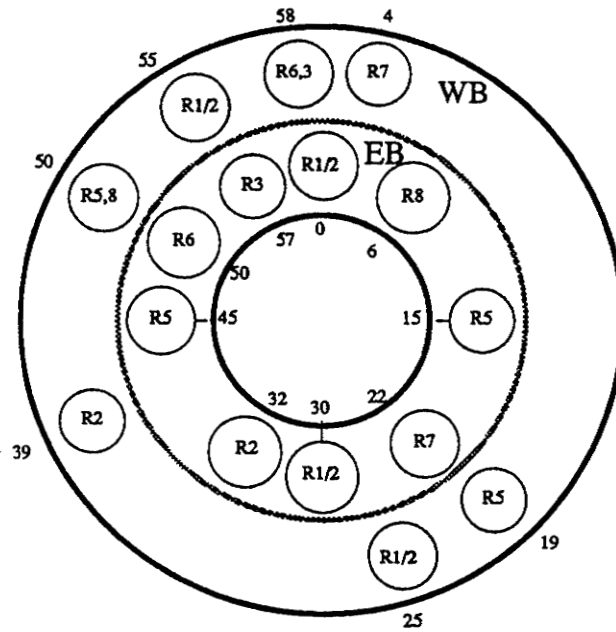


Transfer combinations to/from Trenton (R-7)

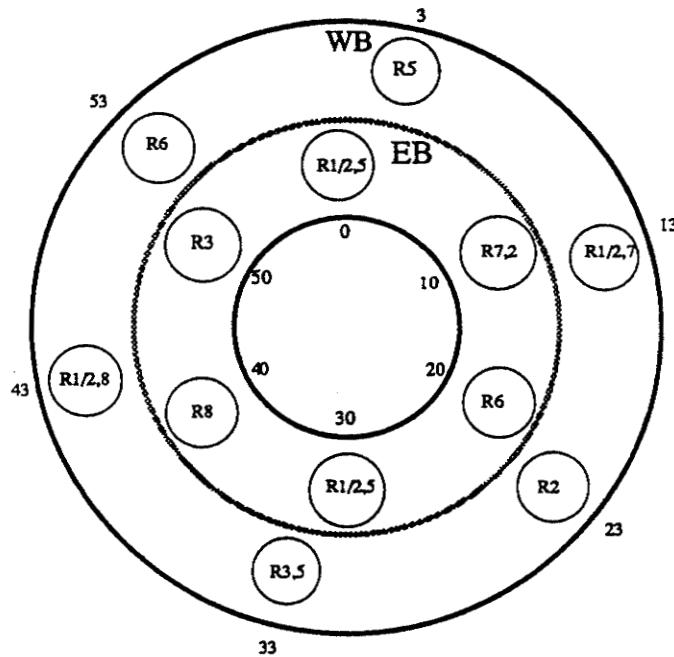


Note: Dashed lines indicate lines which have very small transfer potential

Figure 2.5 Schematic presentation of transfers between R-1 and R-7 as the basic lines, and all other lines



(a) Present Schedule (Effective December 6, 1992)



(b) Recommended Schedule

Notes (1) EB - Eastbound, WB - Westbound

(2) R-1/2: Line section of R-1 and R-2 between the Airport and Glendside/Warminster

(3) R-2: Line section of R-2 between Wilmington and North Broad

Figure 2.6 Present and recommended train arrival times at 30th Street Station presented by clock diagrams

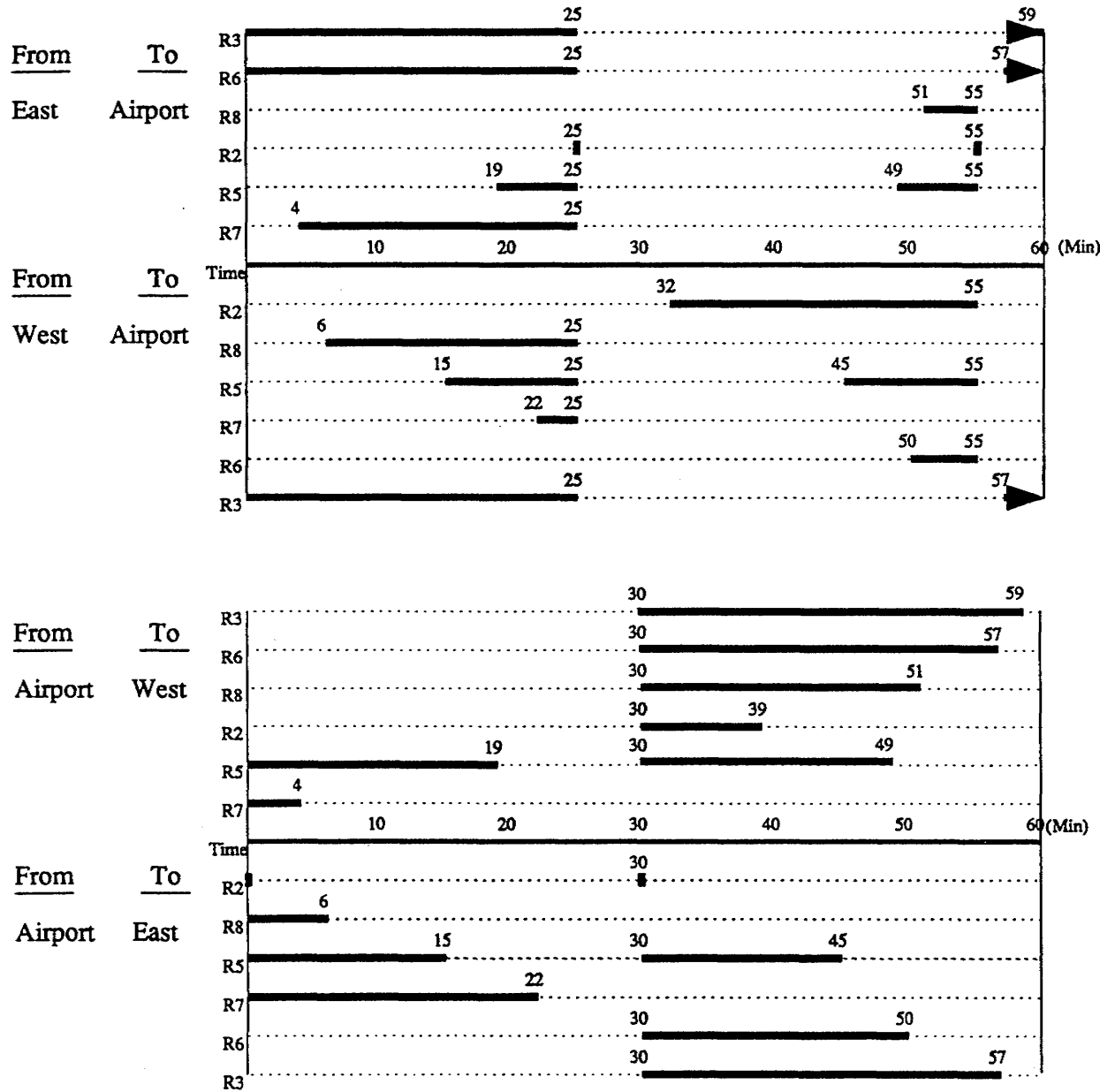


Figure 2.7a Transfer times to/from the Airport Line (R-1/R-2) of the present schedule expressed by a bar-chart

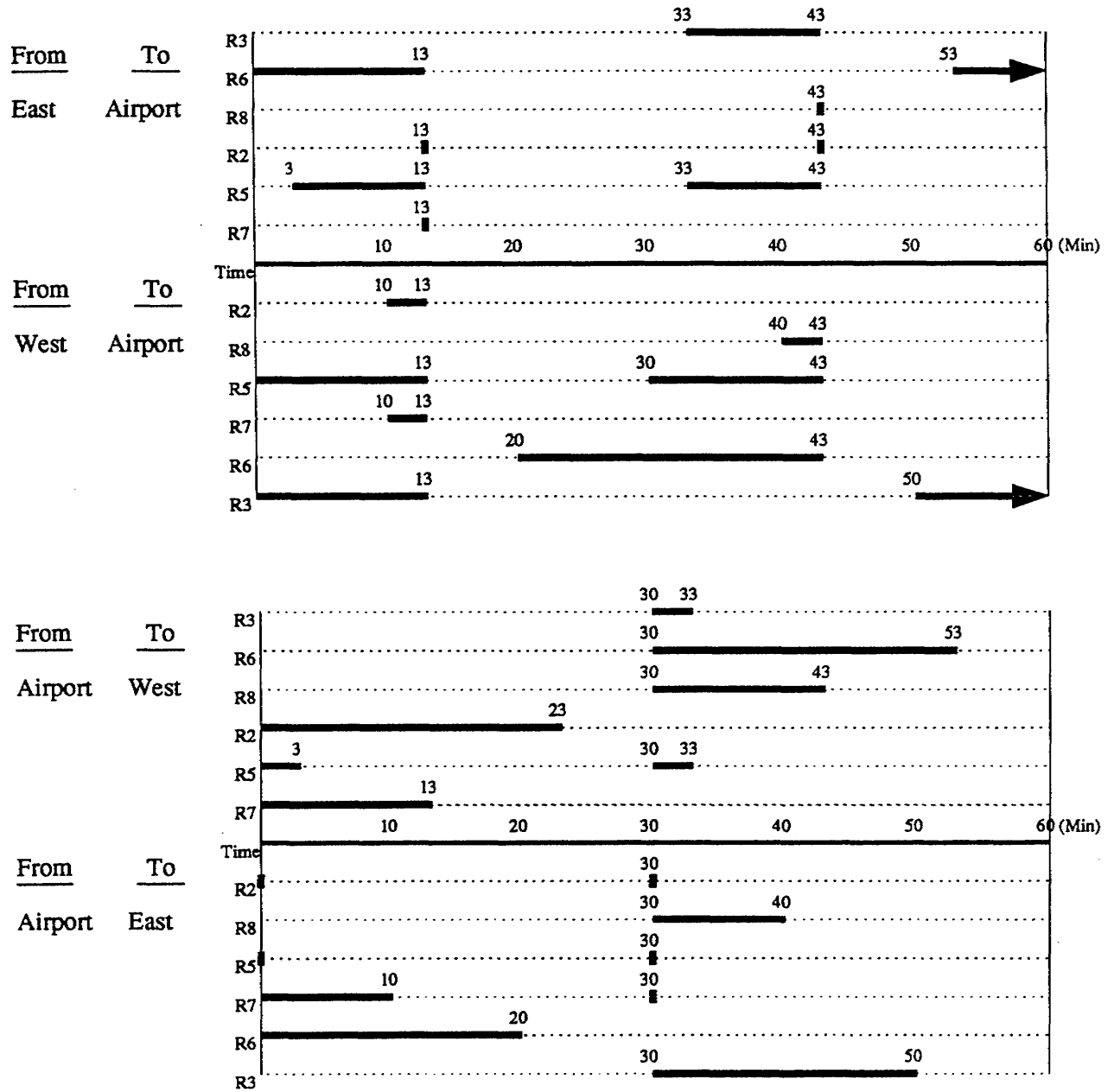


Figure 2.7b Transfer times to/from the Airport Line (R-1/R-2) of the recommended schedule expressed by a bar-chart

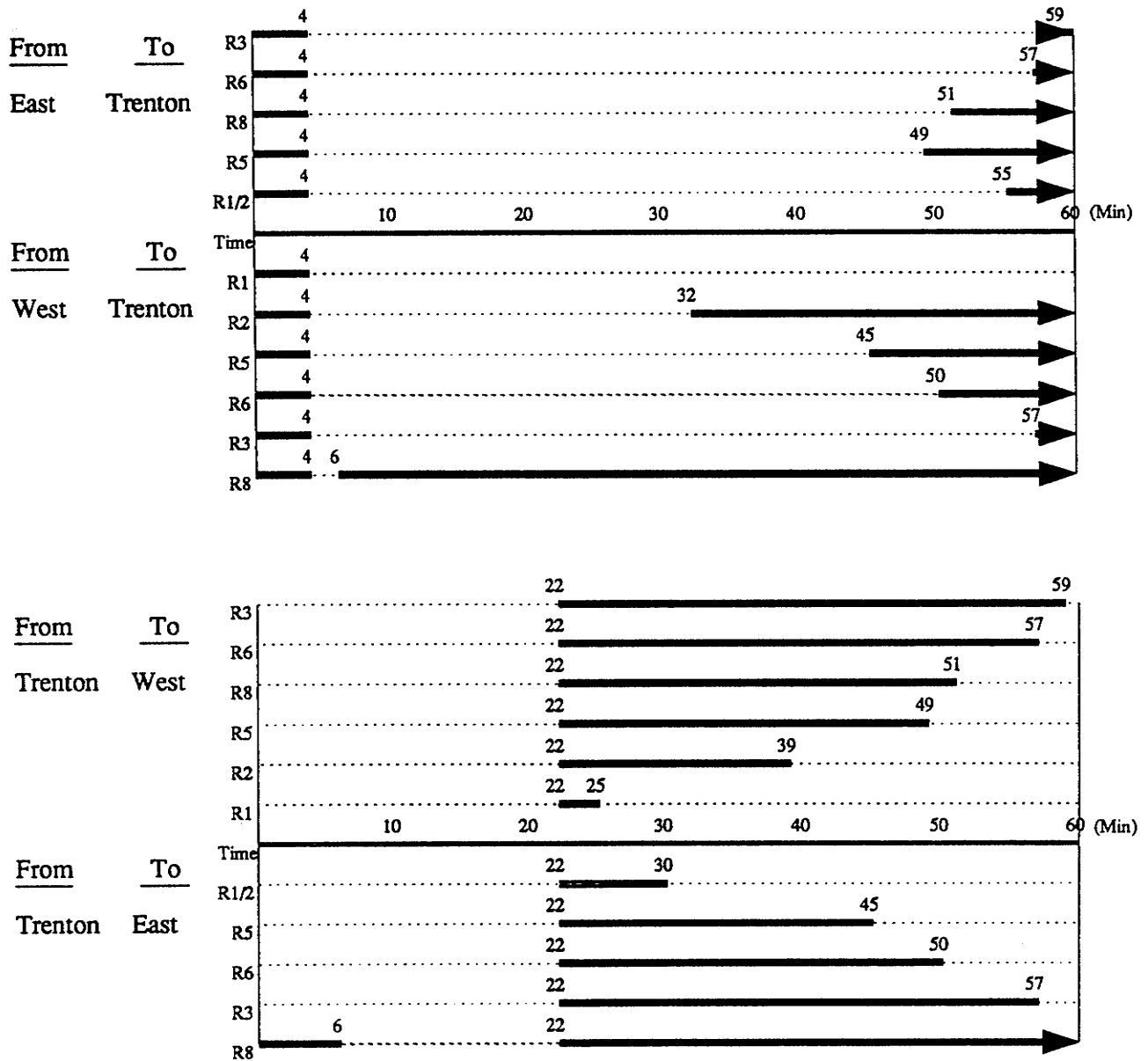


Figure 2.8a Transfer times to/from Trenton (R-7) of the present schedule expressed by a bar-chart

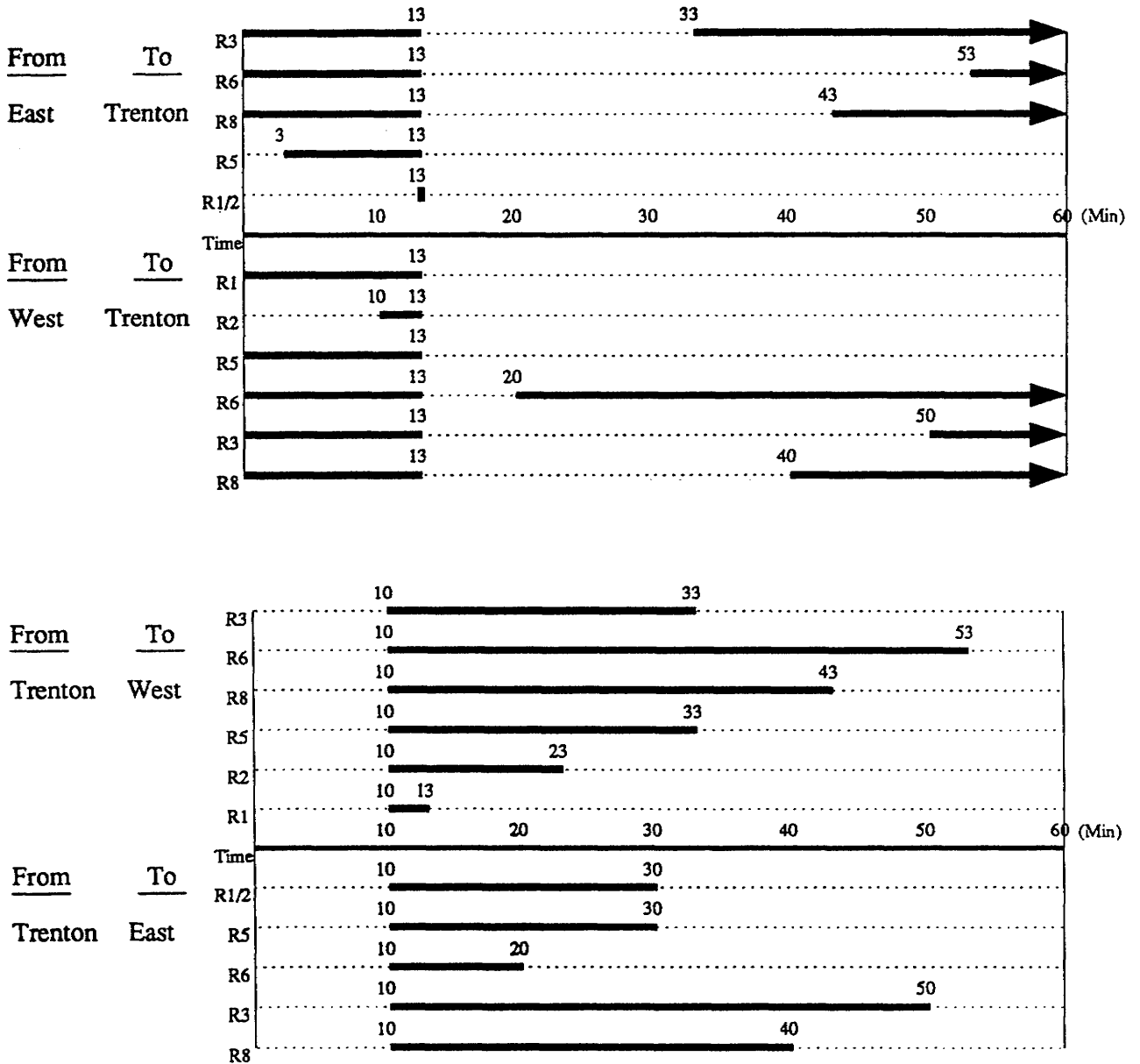


Figure 2.8b Transfer times to/from Trenton (R-7) of the recommended schedule expressed by a bar-chart

represent the transfer times to and from other individual lines.

Figures 2.7a and 2.7b show transfer times to/from the Airport for the present and recommended schedules, respectively. The comparison of the heavy lines in these two diagrams shows that the recommended schedule has generally shorter transfer times than the present schedule.

Figures 2.8a and 2.8b show transfer times to/from the Trenton line in the same manner. Again, the shorter heavy lines in Figure 2.8b indicate that the recommended schedule has decreased transfer times. The sum of all transfer times to and from a line is called the total transfer time. It is an indicator of transfer convenience and service quality.

A numerical summary of the transfer times in Figures 2.7 (a, b) and 2.8 (a, b) is presented in four groups in Table 2.1. The total transfer times to and from R-1 and R-7 presently amount to 858 minutes per hour (the basic module of the schedule); in the recommended schedule this time is 762 minutes, or a reduction of 11%. If the transfer times for the third category (unimportant permutations) are eliminated, the total transfer times change from 705 to 514 minutes, or a 27% decrease.

Consequently, the recommended schedule provides a significant improvement in transfer times, particularly for the most important line connections, those to and from R-1 (Airport) and R-7 (Trenton). In addition, the recommended schedule provides regular headways on the trunk line section (30th Street to Jenkintown). As mentioned, detailed feasibility and fleet requirement calculations have not been performed for this schedule.

The methodology for analysis and presentations developed here can be useful in the development of an improved plan worked out for actual implementation.

2.2 Revision of the R-3 Peak-hour Services

In providing services on Regional Rail lines, one of the main trade-offs in selecting local or accelerated services is between service frequency at individual stations and travel (or operating) speed on the line.

For off-peak services the headways are so long, that the only option is local operation, i.e., each train serves all stations. During the peak hours, however, passenger volumes justify higher service frequencies, and operation of accelerated services -- zonal or skip-stop -- becomes

Table 2.1 Transfer times between R-1 and all other lines, and between R-7 and all other lines

1. Present schedule

Route No. Direction	To Airport	From Airport	To Trenton	From Trenton	Route No. Direction	To Airport	From Airport	To Trenton	From Trenton
R-1 E	-	-	4	8	R-1 W	-	-	9	3
R-2 E	23 ⁽²⁾	0	32	8	R-2 W	0	9 ⁽²⁾	9	17
R-3 E	28	27	7	35 ⁽²⁾	R-3 W	26	29	5 ⁽²⁾	37
R-5 E	10	15	19	23	R-5 W	6	19	15	27
R-6 E	5 ⁽²⁾	20	14 ⁽²⁾	28	R-6 W	28	27 ⁽²⁾	7	35 ⁽²⁾
R-7 E	3	22	-	-	R-7 W	21	4	-	-
R-8 E	19	6	58	44	R-8 W	4	21	13	29

(Source: SEPTA schedule effective December 6, 1992)

Total transfer time is 858 min

When lines with very small potential (see note 2) are excluded, transfer time is 705 min

2. Recommended schedule

Route No. Direction	To Airport	From Airport	To Trenton	From Trenton	Route No. Direction	To Airport	From Airport	To Trenton	From Trenton
R-1 E	-	-	13	20	R-1 W	-	-	0	3
R-2 E	3 ⁽²⁾	0	3	20	R-2 W	0	23 ⁽²⁾	0	13
R-3 E	23	20	23	40 ⁽²⁾	R-3 W	10	3	40 ⁽²⁾	23
R-5 E	13	0	13	20	R-5 W	10	3	10	23
R-6 E	23 ⁽²⁾	20	53 ⁽²⁾	10	R-6 W	20	23 ⁽²⁾	20	43 ⁽²⁾
R-7 E	3	10	-	-	R-7 W	0	13	-	-
R-8 E	3	10	33	30	R-8 W	0	13	30	33

Total transfer time is 762 min

When lines with very small potential (see note 2) are excluded, transfer time is 514 min

Notes (1): E - Eastbound, W - Westbound

(2): For to/from the Airport: R2(Between Wilmington and CBD) and R6(Between Cynwyd and CBD);

For to/from Trenton: R3(Between CBD and W. Trenton) and R6(Between Cynwyd and CBD).

possible. Although the increased speed provided by these services becomes attractive, there may be cases when the inconvenience of increased headways may be too great to be outweighed by the gains from higher speed of accelerated runs.

The R-3 line between Elwyn and Center City has been used for an analysis of alternative types of peak-hour services.

2.2.1 Present Schedule

The a.m. peak hour schedule of the R-3 line is given in Table 2.2 and plotted graphically in Figure 2.9. As the figure shows, peak-hour service consists of 10 train runs arriving at the 30th Street Station between 6:20 and 9:20 a.m. Of these 10 runs, four perform a kind of zonal service: two of these serve the Elwyn-Secane zone and run express from Secane to 30th Street Station; two others serve Elwyn and Media, skip only three stations, then serve locally from Morton to 30th Street. One additional train is a short-turn local: it serves only the Secane-30th Street section.

A numerical summary of the present R-3 a.m. peak-hour services is presented in Table 2.3. It gives for each station total frequency for the three-hour period, all headways, travel times and number of stoppings to 30th Street. An analysis of Tables 2.2 and 2.3 leads to the following evaluations of the present service.

Advantages of the present service are:

- + Passengers from Elwyn and Media enjoy express running on four trains; these time savings amount to, respectively, 10 and 4 minutes for the two types of expresses;
- + Passengers from Moylan to Secane stations using the two expresses save 10 minutes;
- + In addition to the reduced travel times, passengers on the express trains enjoy less disturbance due to fewer stoppings at stations along the line;
- + Shorter travel time of the expresses results in shorter train cycle times, which may allow better rolling stock utilization.

Table 2.2 The present R-3 schedule, a.m. peak

Km	Miles	Station	Present R-3 schedule									
			5.40	6.10	6.35	6.57	7.07	7.21		7.47	7.57	8.34
0.0	0.0	ELW	5.44	6.14	6.39	7.01	7.16	7.25		7.51	8.01	8.38
1.6	1.0	MED	5.46	6.16	6.41	E	7.18	E		7.53	8.03	8.40
2.9	1.8	MRV	5.48	6.18	6.43	X	7.20	X		7.55	8.05	8.42
4.3	2.7	WLF	5.51	6.21	6.46	P	7.23	P		7.58	8.08	8.45
6.1	3.8	SWM	5.54	6.24	6.49	7.07	7.26	7.31		8.01	8.11	8.48
8.2	5.1	MOR	5.57	6.27	6.52	7.10	7.29	7.34	7.49	8.04	8.14	8.51
10.0	6.2	SEC	5.59	6.29	6.54	7.12	E	7.36	7.51	E	8.16	8.53
11.1	6.9	FRM	6.01	6.31	6.56	7.14	X	7.38	7.53	X	8.18	8.55
12.1	7.5	CFT	6.03	6.33	6.58	7.16	P	7.40	7.55	P	8.20	8.57
13.0	8.1	GLD	6.05	6.35	7.00	7.18	R	7.42	7.57	R	8.22	8.59
14.0	8.7	LND	6.07	6.37	7.02	7.20	E	7.44	7.59	E	8.24	9.01
15.4	9.6	FNW	6.09	6.39	7.04	7.22	S	7.46	8.01	S	8.26	9.03
17.1	10.6	ANG	6.12	6.42	7.07	7.25	S	7.49	8.04	S	8.29	9.06
19.0	11.8	49S	6.20	6.50	7.15	7.33	7.43	7.57	8.12	8.17	8.37	9.14
22.7	14.1	30S										

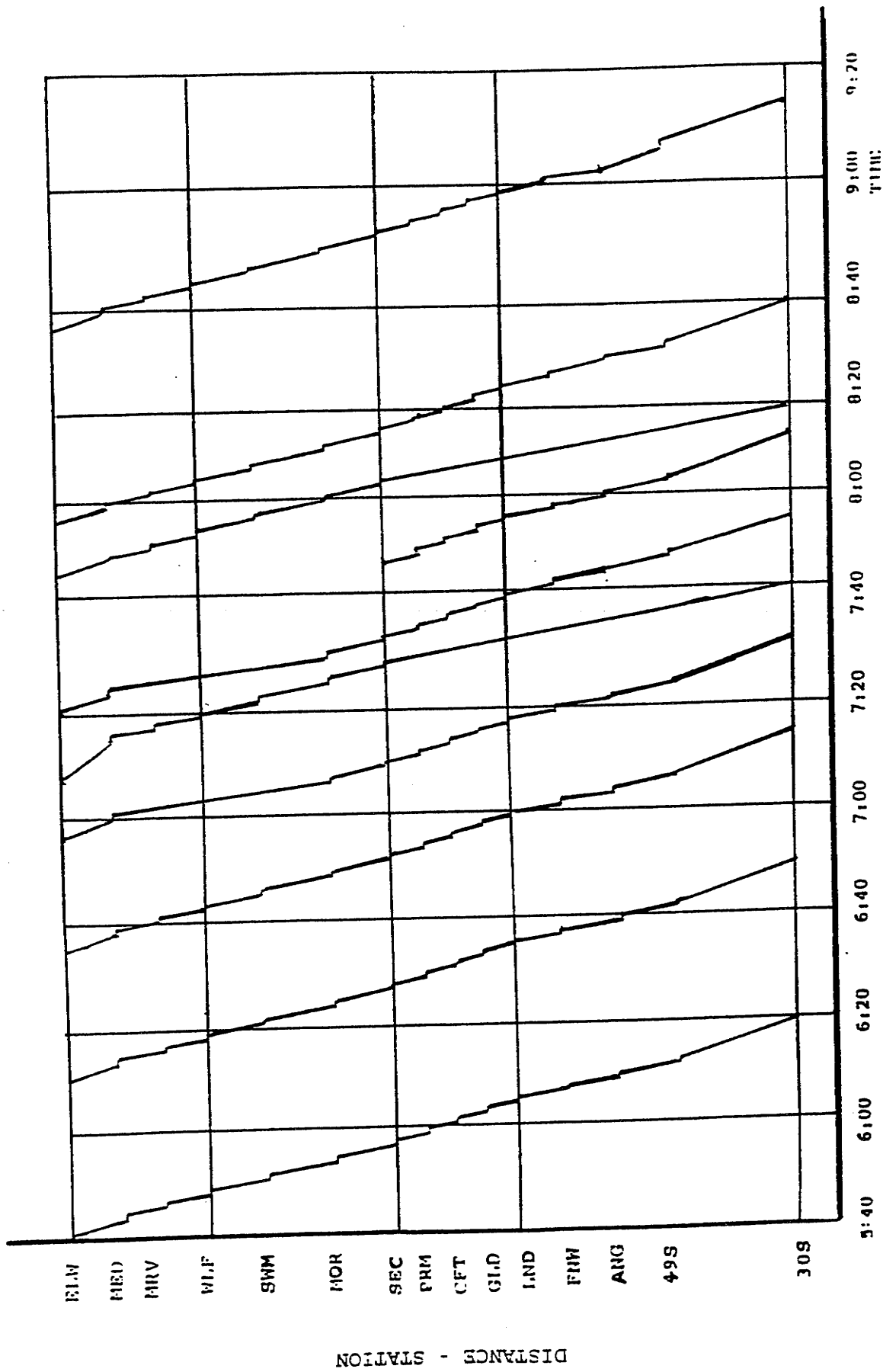


Figure 2.9 The present R-3 schedule, a.m. peak

DISTANCE - STATION

Table 2.3 Service elements of the present R-3 service, a.m. peak

Km	Miles	Station	Frequency (trains/3hrs)	Headway (min)						Travel time to 30th street station(min)	Stops to 30th street station		
				30	25	22	10	14	26				
0.0	0.0	ELW	9	30	25	22	10	14	26	10	37	40,36,30	13,10,6
1.6	1.0	MED	9	30	25	22	15	9	26	10	37	36,32,27,26	12,9,5
2.9	1.8	MRV	7	30	25	-	37	-	35	10	37	34,25,24	11,4
4.3	2.7	WLF	7	30	25	-	37	-	35	10	37	32,23,22	10,3
6.1	3.8	SMM	7	30	25	-	37	-	35	10	37	29,20,19	9,2
8.2	5.1	MOR	9	30	25	18	19	5	35	10	37	26,17,16	8,1
10.0	6.2	SEC	10	30	25	18	19	5	15	15	10	23,14,13	7,0
11.1	6.9	PRM	8	30	25	18	-	24	15	-	25	21	6
12.1	7.5	CFT	8	30	25	18	-	24	15	-	25	19	5
13.0	8.1	GLD	8	30	25	18	-	24	15	-	25	17	4
14.0	8.7	LND	8	30	25	18	-	24	15	-	25	15	3
15.4	9.6	FNW	8	30	25	18	-	24	15	-	25	13	2
17.1	10.6	ANG	8	30	25	18	-	24	15	-	25	11	1
19.0	11.8	49S	8	30	25	18	-	24	15	-	25	8	0
22.7	14.1	30S	10	30	25	18	10	14	15	15	20	-	-

Disadvantages of the present service are:

- Headways at all stations are very irregular. They vary from 5 to 37 minutes; headways among arrival times at 30th Street from individual stations along the line vary from 10 to 37 minutes;
- Headways at many stations are excessively long: even in the middle of the peak hours a number of stations have headways of 35-37 minutes;
- Irregular operations are much more sensitive to delays than schedules with regular headways and stopping patterns;
- Long headways result in long station standing times, partly off-setting the benefits of express runs;
- The main potential cost-reducing benefit of zonal services - to short-turn some trains and thereby obtain extra runs - is not realized due to the fact that the trains serving the inner zone (30th Street - Secane) continue their runs to Elwyn.

2.2.2 Possible Alternative Schedules

Three alternative schedule revisions have been considered: all-local (L), skip-stop (S-S) and zonal (Z). All three schedules have been stipulated to consist of the same number of runs as the present schedule, i.e. 10 trains arriving at the 30th Street in the three-hour period, 6:20-9:20 a.m.

i. Local Service consists of all trains running as locals, serving all stations at regular headways. Two variations of this service, shown in Figures 2.10, 2.11 and Table 2.4, are analyzed: L-1, having 15-min headways leaving Elwyn from 5:40 to 8:25 a.m., except the first and the last headways, which would be 30 min.; and L-2, using 20-min headways leaving Elwyn between 5:40 and 8:50 a.m., except the first one, which would be 30 min. Thus, the former would provide a better service (shorter headways), but only until 7:55 a.m., while the latter would have 20-min. headways until 8:50 a.m.

Compared to the present schedule, the local service would have the following characteristics:

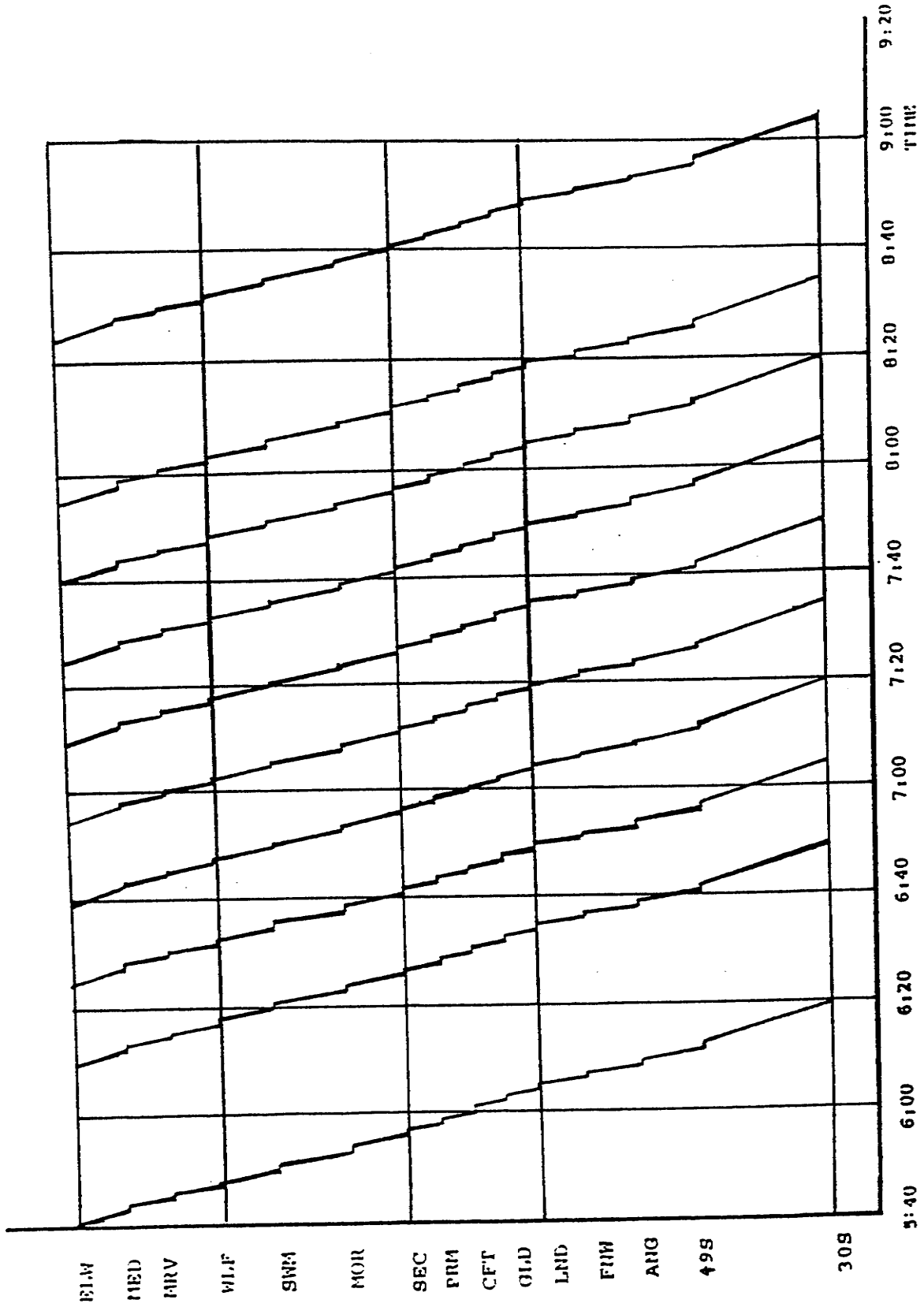


Figure 2.10 R-3 all-local, 15-min headways (L-1)

DISTANCE - STATION

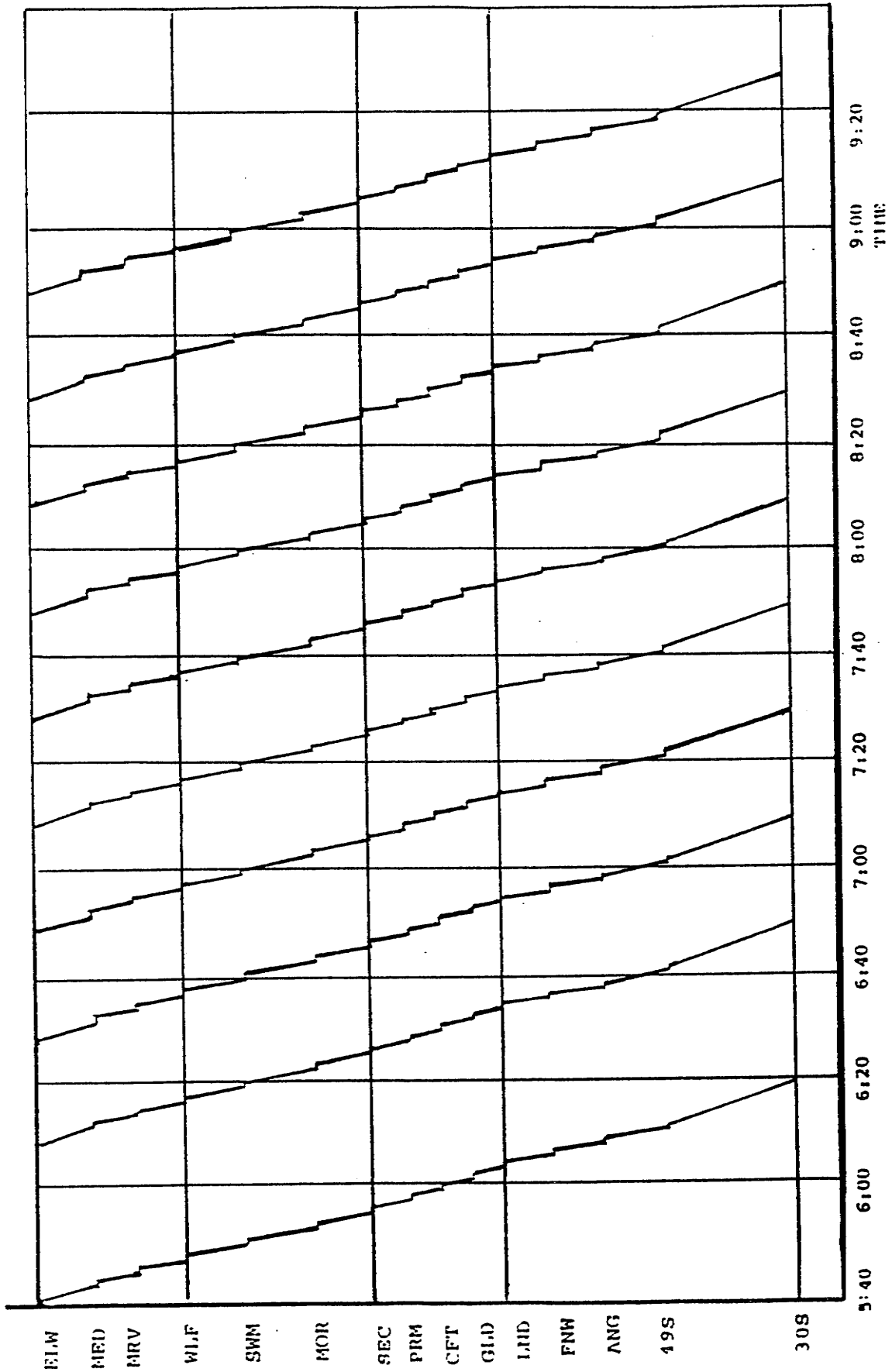


Figure 2.11 R-3 all-local, 20-min headways (L-2)

DISTANCE - STATION

Table 2.4 R-3 all-local schedules, a.m. peak (L-1,L-2)

Station	Local operation (1)										Local operation (2)									
ELW	5.40	6.10	6.25	6.40	6.55	7.10	7.25	7.40	7.55	8.25	5.40	6.10	6.30	6.50	7.10	7.30	7.50	8.10	8.30	8.50
MED	5.44	6.14	6.29	6.44	6.59	7.14	7.29	7.44	7.59	8.29	5.44	6.14	6.34	6.54	7.14	7.34	7.54	8.14	8.34	8.54
MRV	5.46	6.16	6.31	6.46	7.01	7.16	7.31	7.46	8.01	8.31	5.46	6.16	6.36	6.56	7.16	7.36	7.56	8.16	8.36	8.56
WLF	5.48	6.18	6.33	6.48	7.03	7.18	7.33	7.48	8.03	8.33	5.48	6.18	6.38	6.58	7.18	7.38	7.58	8.18	8.38	8.58
SWM	5.51	6.21	6.36	6.51	7.06	7.21	7.36	7.51	8.06	8.36	5.51	6.21	6.41	7.01	7.21	7.41	8.01	8.21	8.41	9.01
MOR	5.54	6.24	6.39	6.54	7.09	7.24	7.39	7.54	8.09	8.39	5.54	6.24	6.44	7.04	7.24	7.44	8.04	8.24	8.44	9.04
SEC	5.57	6.27	6.42	6.57	7.12	7.27	7.42	7.57	8.12	8.42	5.57	6.27	6.47	7.07	7.27	7.47	8.07	8.27	8.47	9.07
PRM	5.59	6.29	6.44	6.59	7.14	7.29	7.44	7.59	8.14	8.44	5.59	6.29	6.49	7.09	7.29	7.49	8.09	8.29	8.49	9.09
CFT	6.01	6.31	6.46	7.01	7.16	7.31	7.46	8.01	8.16	8.46	6.01	6.31	6.51	7.11	7.31	7.51	8.11	8.31	8.51	9.11
GLD	6.03	6.33	6.48	7.03	7.18	7.33	7.48	8.03	8.18	8.48	6.03	6.33	6.53	7.13	7.33	7.53	8.13	8.33	8.53	9.13
LND	6.05	6.35	6.50	7.05	7.20	7.35	7.50	8.05	8.20	8.50	6.05	6.35	6.55	7.15	7.35	7.55	8.15	8.35	8.55	9.15
FNW	6.07	6.37	6.52	7.07	7.22	7.37	7.52	8.07	8.22	8.52	6.07	6.37	6.57	7.17	7.37	7.57	8.17	8.37	8.57	9.17
ANG	6.09	6.39	6.54	7.09	7.24	7.39	7.54	8.09	8.24	8.54	6.09	6.39	6.59	7.19	7.39	7.59	8.19	8.39	8.59	9.19
49S	6.12	6.42	6.57	7.12	7.27	7.42	7.57	8.12	8.27	8.57	6.12	6.42	7.02	7.22	7.42	8.02	8.22	8.42	9.02	9.22
30S	6.20	6.50	7.05	7.20	7.35	7.50	8.05	8.20	8.35	9.05	6.20	6.50	7.10	7.30	7.50	8.10	8.30	8.50	9.10	9.30

- + Much shorter headways at most stations;
- + Regular headways, easy to memorize, for all stations;
- + Simpler, convenient service with connections among all stations by each train;
- Longer travel times for passengers from stations between Elwyn and Secane;
- Lower convenience (more stopping) and loss of image which express trains have due to their non-stop running on some sections.

ii. Skip-stop Service would consist of two types of trains, A and B, each one stopping at all major stations and at different sets of minor stations. This service is plotted on a time-distance diagram in Figure 2.12 and its schedule is shown in Table 2.5.

The skip-stop service would provide travel with shorter travel times than local service, but at the expense of lower service frequency at all A and B stations, where it would be only a half (double length headways) of the local service. Another disadvantage would be that there would not be direct service between any A and any B station. Although not many passengers travel between such station pairs, this aspect should be considered very carefully, because intrasuburban trips are those that SEPTA should particularly be interested in attracting or generating.

iii. Zonal Service would consist of two zones, one from 30th Street to Secane, and the other from Secane to Elwyn, as shown in Figure 2.13 and Table 2.6. Most stations would have service with 30-min. headways; passengers from the outer zone would enjoy express travel from Secane to 30th Street. This zonal service would be similar to the present peak-hour service, except that all trains serving the first zone (30th Street to Secane) would be turned back at Secane instead of running to Elwyn. This would decrease train- and car-miles (km) in comparison with the present operation.

2.2.3 Evaluation and Comparison of Alternative Schedules

The present peak-hour schedules have two major deficiencies: headways at most stations are very long (up to 37 min.), and they are irregular, as their listing in Table 2.7 shows. Peak hour headways which are longer than 20 minutes are not at all attractive for commuters. For example, with headways of 35 min. a person may have to arrive at his/her destination (workplace or a meeting) 30 minutes before the desired time. It is well known that this deters a considerable number of potential SEPTA customers from using its services. Consequences of

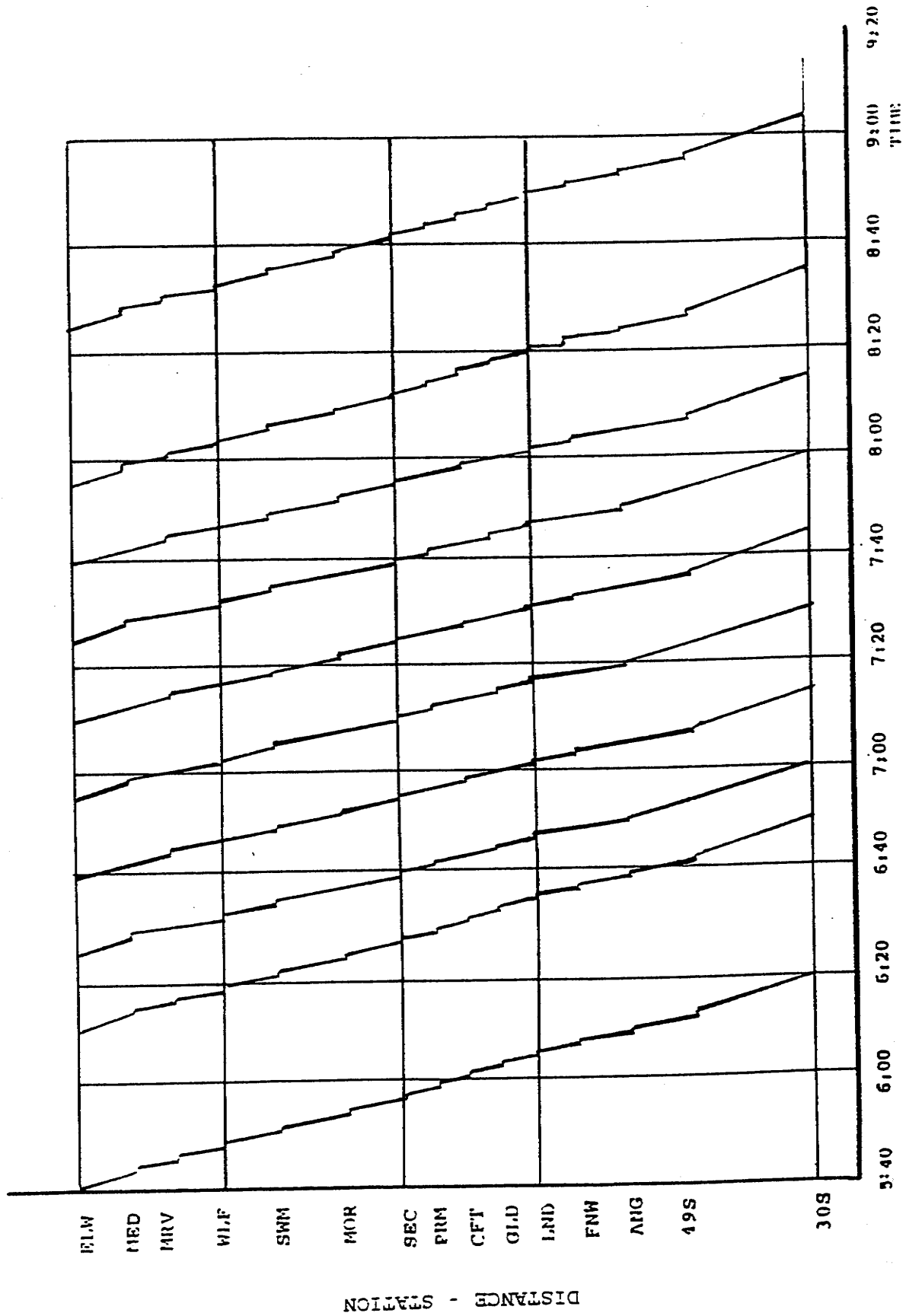


Figure 2.12 R-3 skip-stop operation, a.m. peak (S-S)

DISTANCE - STATION

Table 2.5 R-3 skip-stop schedule, a.m. peak (S-S)

Station	Skip-stop operation									
ELW	5.40	6.10	6.25	6.40	6.55	7.10	7.25	7.40	7.55	8.25
MED	5.44	6.14	6.29	-	6.59	-	7.29	-	7.59	8.29
MRV	5.46	6.16	-	6.45	-	7.15	-	7.45	8.01	8.31
WLF	5.48	6.18	6.32	-	7.02	-	7.32	-	8.03	8.33
SWM	5.51	6.21	6.35	6.49	7.05	7.19	7.35	7.49	8.06	8.36
MOR	5.54	6.24	-	6.52	-	7.22	-	7.52	8.09	8.39
SEC	5.57	6.27	6.40	6.55	7.10	7.25	7.40	7.55	8.12	8.42
PRM	5.59	6.29	6.42	-	7.12	-	7.42	-	8.14	8.44
CFT	6.01	6.31	-	6.58	-	7.28	-	7.58	8.16	8.46
GLD	6.03	6.33	6.45	-	7.15	-	7.45	-	8.18	8.48
LND	6.05	6.35	6.47	7.01	7.17	7.31	7.47	8.01	8.20	8.50
FNW	6.07	6.37	-	7.03	-	7.33	-	8.03	8.22	8.52
ANG	6.09	6.39	6.50	-	7.20	-	7.50	-	8.24	8.54
49S	6.12	6.42	-	7.07	-	7.37	-	8.07	8.27	8.57
30S	6.20	6.50	7.00	7.15	7.30	7.45	8.00	8.15	8.35	9.05

Table 2.6 R-3 zonal schedule, a.m. peak (Z)

Station	Zonal operation									
ELW	5.40	6.10	6.25		6.55		7.25		7.55	8.25
MED	5.44	6.14	6.29		6.59		7.29		7.59	8.29
MRV	5.46	6.16	6.31		7.01		7.31		8.01	8.31
WLF	5.48	6.18	6.33		7.03		7.33		8.03	8.33
SWM	5.51	6.21	6.36		7.06		7.36		8.06	8.36
MOR	5.54	6.24	6.39		7.09		7.39		8.09	8.39
SEC	5.57	6.27	6.42	6.48	7.12	7.18	7.42	7.48	8.12	8.42
PRM	5.59	6.29	-	6.50	-	7.20	-	7.50	8.14	8.44
CFT	6.01	6.31	-	6.52	-	7.22	-	7.52	8.16	8.46
GLD	6.03	6.33	-	6.54	-	7.24	-	7.54	8.18	8.48
LND	6.05	6.35	-	6.56	-	7.26	-	7.56	8.20	8.50
FNW	6.07	6.37	-	6.58	-	7.28	-	7.58	8.22	8.52
ANG	6.09	6.39	-	7.00	-	7.30	-	8.00	8.24	8.54
49S	6.12	6.42	-	7.03	-	7.33	-	8.03	8.27	8.57
30S	6.20	6.50	6.56	7.11	7.26	7.41	7.56	8.11	8.35	9.05

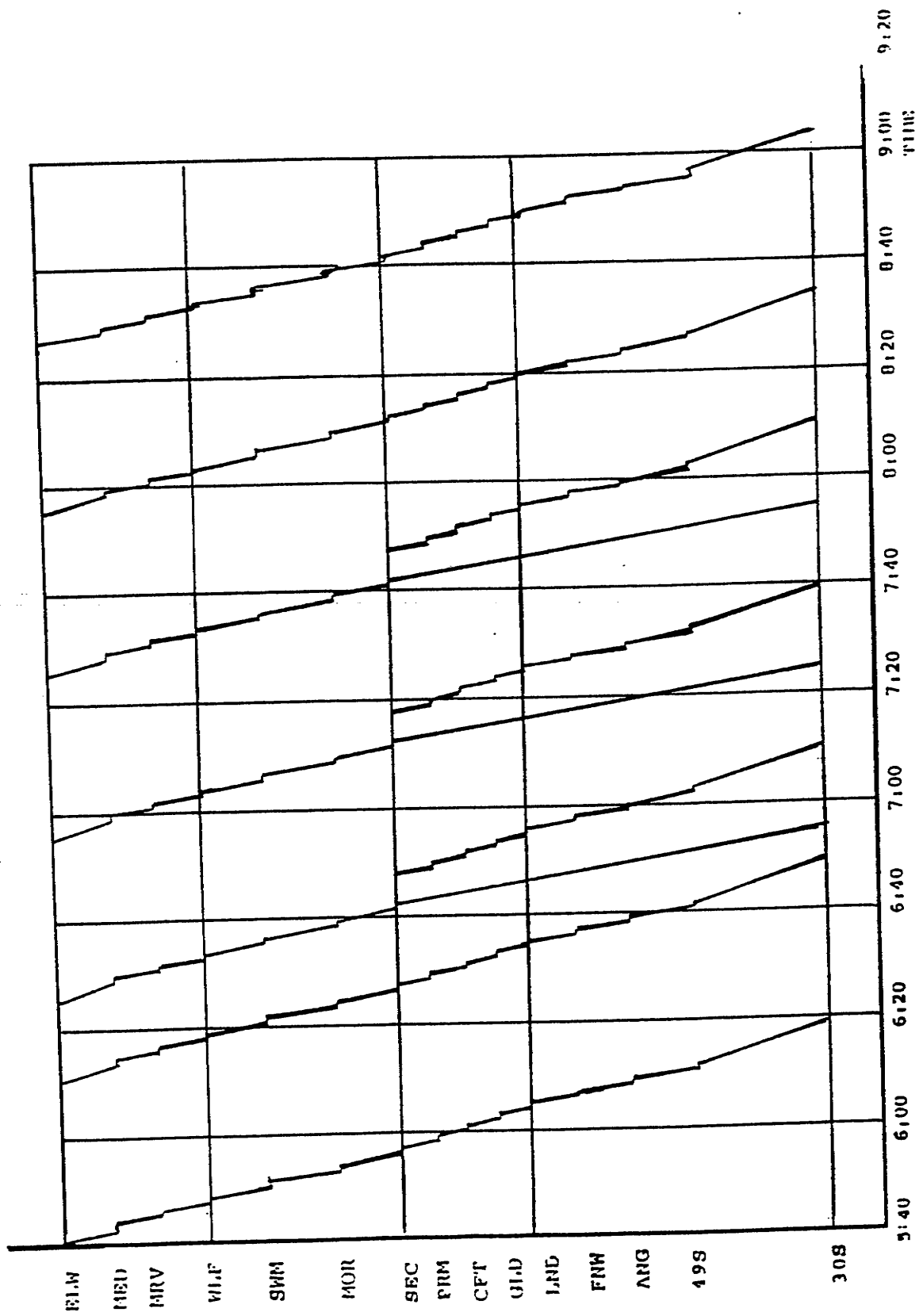


Figure 2.13 R-3 zonal operation, a.m. peak (Z)

DISTANCE - STATION

Table 2.7 Summary of R-3 alternative schedules

Station	Local operation (1)			Local operation (2)			Skip-stop operation			Zonal operation						
	f	h	t	n	f	h	t	n	f	h	t	n				
ELW	10	15	40	13	10	20	40	13	10	15	35	8	7	30	31	6
MED	10	15	36	12	10	20	36	12	7	30	31	7	7	30	27	5
MRV	10	15	34	11	10	20	34	11	7	30	30	7	7	30	25	4
WLF	10	15	32	10	10	20	32	10	7	30	28	6	7	30	23	3
SMM	10	15	29	9	10	20	29	9	10	14,16	25,26	5,6	7	30	20	2
MCR	10	15	26	8	10	20	26	8	7	30	23	5	7	30	17	1
SEC	10	15	23	7	10	20	23	7	10	15	20	4	10	6,24	14,23	0,7
FRM	10	15	21	6	10	20	21	6	7	30	18	3	7	30	21	6
CFT	10	15	19	5	10	20	19	5	7	30	17	3	7	30	19	5
GLD	10	15	17	4	10	20	17	4	7	30	15	2	7	30	17	4
LND	10	15	15	3	10	20	15	3	10	14,16	13,14	1,2	7	30	15	3
FNW	10	15	13	2	10	20	13	2	7	30	12	1	7	30	13	2
ANG	10	15	11	1	10	20	11	1	7	30	10	0	7	30	11	1
49S	10	15	8	0	10	20	8	0	7	30	8	0	7	30	8	0
30S	10	15	-	-	10	20	-	-	10	15	-	-	10	15	-	-
SUM	150				150				120				111			

f: frequency (trains/3hrs)

h: headway (min)

t: travel time to 30th Street Station (min)

n: number of stops to 30th Street Station

these losses should require no elaboration. Correcting these deficiencies has been the main objective in developing these alternative schedules.

Table 2.8 presents a summary of operating elements of the three alternate schedules: Local (L), Skip-stop (S), and Zonal (Z). The table shows that local operation provides by far the most frequent and regular services among all alternatives. Travel time differences between the two Local and two accelerated services exist for stations between Secane and Elwyn: for the Skip-stop operation they are not very significant, amounting to only 4-5 minutes. For the Zonal operation they amount to 9-10 minutes.

It should be noted that these differences in travel times could be reduced by faster schedules which would be possible for Local operations: **with shorter headways and more stations served, these trains would have less concentrated passenger loads, so that their standing times at stations could be reduced.** Travel time savings by accelerated services would thus be even less significant.

The differences in the numbers of stoppings would remain as they are now: passengers between Secane and Elwyn on the Local trains would experience between 5 and 7 more stoppings than those using the accelerated (Skip-stop and Zonal, respectively) trains. This would be the only major disadvantage of the local operations.

2.2.4 Conclusions and Recommendations

The preceding analysis of the present R-3 schedules between 30th Street and Elwyn and possible alternative schedules shows that introduction of local services with regular headways would offer noticeable improvements: most stations would get considerably increased frequencies, and since maximum headways would be significantly reduced, regularity and reliability would also be improved. The scheduling constraint at the Arsenal interlocking due to divergence of R-1, R-2, R-3 and Amtrak trains would be easier to resolve with regular headways of all-local services.

Disadvantages of longer travel time and more stops would be considerably less significant than these benefits for several reasons. First, only passengers from the outer section of the line would be affected negatively; second, negative effects would not be very significant, and even the affected passengers would experience the benefits of regular and shorter headways. These

Table 2.8 Comparison of R-3 alternative schedules

Km	Miles	Station	Headway (min)				Travel time to CBD (min)				Number of stops to CBD			
			L ₁	L ₂	S-S	Z	L ₁	L ₂	S-S	Z	L ₁	L ₂	S-S	Z
0.0	0.0	Elwyn	15	20	15	30	40	40	35	31	14	14	9	7
1.6	1.0	Media	15	20	30	30	36	36	30	27	13	13	8	6
2.9	1.8	Moylan-Rose Valley	15	20	30	30	34	34	30	25	12	12	8	5
4.3	2.7	Wallingford	15	20	30	30	32	32	27	23	11	11	7	4
6.1	3.8	Swarthmore	15	20	15	30	29	29	24,26	20	10	10	6,7	3
8.2	5.1	Morton	15	20	30	30	26	26	23	17	9	9	6	2
9.9	6.2	Secane	15	20	15	7,23	23	23	20	14,23	8	8	5	1,8
11.0	6.9	Primos	15	20	30	30	21	21	18	21	7	7	4	7
12.0	7.5	Clifton-Aldan	15	20	30	30	19	19	17	19	6	6	4	6
13.0	8.1	Gladstone	15	20	30	30	17	17	15	17	5	5	3	5
13.9	8.7	Landsdowne	15	20	15	30	15	15	13,14	15	4	4	2,3	4
15.4	9.6	Fernwood	15	20	30	30	13	13	12	13	3	3	2	3
17.0	10.6	Angora	15	20	30	30	11	11	10	11	2	2	1	2
18.9	11.8	49th Street	15	20	30	30	8	8	8	8	1	1	1	1
22.6	14.1	30th Street Station	15	20	15	15,15	-	-	-	-	0	0	0	0

L-1: local operation, 15 min headway
L-2: local operation, 20 min headway
S-S: skip-stop operation

conclusions can be seen by comparing the headways of the present service given in Table 2.3 with the headways of alternative services given in Table 2.7.

Recommendation 2.1

Prepare and implement a six-month demonstration of L-2 (local with 20 min headways) service on the R-3 line between 30th Street Station and Elwyn. Conduct an evaluation consisting of a comparison of ridership volumes, passenger satisfaction, revenues and operational aspects. If this evaluation is favorable to the new type of operations, make this change permanent.

The proposed change would yield information about the trade-off between service frequency (headways) and travel speed which would be useful for similar decisions not only for R-3, but also for most other Regional Rail lines.

QUALITY OF FACILITIES

Aesthetics, visual impression and condition of cars and stations greatly influence the image, attractiveness and, above all, the role the Regional Rail System plays in the Philadelphia Region. Realizing this fact, many transit agencies have introduced many innovations in recent years, aimed at increased attractiveness and physical/psychological comfort of the riders. These innovations have often played a significant role in maintaining or increasing competitiveness of transit in comparison with the private automobile.

Quality of facilities includes a variety of aspects, from air conditioning and comfortable seating to cleanliness and comfort in stations for waiting passengers.

3.1 Car Cleanliness

The Regional Rail System has been traditionally operated with laissez-fair policy toward cleanliness. Leaving entire newspapers on the seats (or, by those "socially conscious", stuffed between the seat and the wall), sometimes even dispersed on the floor, cans sometimes rolling on the floor - were blindly considered as unchangeable habits of the American public.

A significant improvement was made after SEPTA's takeover, when large trash cans and baskets were provided at all stations and regularly emptied. Another major improvement was the complete prohibition of smoking, introduced in mid-1980s, which was accepted with an overwhelming approval and negligible complaints.

The first significant action to improve car cleanliness in many years, the "Stash your trash" campaign, was introduced recently, with considerable publicity. Contrary to the previously held skeptical beliefs that not much can be done about the habits of passengers, this cleanliness campaign has had visible positive results. It changed attitudes of many passengers and improved the atmosphere from laissez-fair to a controlled, more "classy" environment, where passengers feel that the "in thing" is not to leave "Daily News" on the floor, but to take it out and drop in the trash basket. The vigorous campaign has, however, faded gradually and now completely ceased, with consequent slippage in cleanliness and return of the sloppy appearance.

Several major problems remain from the traditional defeatist attitudes toward the possibility of maintaining high level of car cleanliness: eating and drinking, prohibited on other SEPTA vehicles, is still allowed on Regional Rail trains. This often results in cans and trash lying or rolling over the floor; instructions on how to dispose of newspapers and trash are not always easy to see; trash left on the seats and floor are not removed by the crew, so that it remains sometimes throughout the day. This is particularly problem on weekends, when cleaning is reduced or eliminated; warnings and instructions for keeping cleanliness are not as prominent as they should be, and the fact that the crews ignore this problem gives a bad image to SEPTA's interest and degree of control over its services.

Recommendation 3.1

Prohibit food consumption on the trains (consistent with such regulation on other SEPTA Divisions);

Recommendation 3.2

Reintroduce, intensify and make permanent the campaign for car cleanliness;

Recommendation 3.3

Make it a crew duty to announce instructions about cleanliness and food prohibition during the travel on the maximum load section (usually leaving and approaching the 30th Street and/or Market East Stations); at terminals the crew should collect major items of "clean trash", such as newspapers and packages, if they are still left by passengers.

3.2 Station Improvements

A number of improvements in station appearance and maintenance are needed, but these greatly depend on the financing conditions; therefore they are not in the scope of this study. A major present deficiency which has a serious negative impact on passenger attraction is the condition of the 30th Street Station Regional Rail section.

SEPTA's Regional Rail platforms were reconstructed and greatly improved; however,

as a consequence of this renovation, passengers using this station have been greatly inconvenienced for a "transition" time period which has now been nearly five years long.

The problems include:

- **Inconsistent signing:** SEPTA's prominent "Regional Rail" signs are preceded by Amtrak's "Commuter Lines" signs referring to the same system.
- The recently installed information kiosks are very useful and popular, but they need further improvements: their map of the surrounding area shows Mantua, but not Center City nor the Historic Area, main destinations of hundreds of Amtrak passengers who come to the city every day.
- **The connection between the Blue/Green Line and the Regional Rail Lines at the 30th Street Station** remains not inadequate, but non-existent: difficult to "discover", difficult to negotiate between taxis and other vehicles, and blocked by virtual lakes whenever it rains. This is, of course, only partly SEPTA's problem, but it is essential that SEPTA continues initiatives with the City and Amtrak to resolve it. The future of the entire 30th Street Station commercial redevelopment and thus SEPTA's major future ridership source is at stake.
- **Misleading signs and instructions:** a sign shows SEPTA's Ticket Office in the wrong direction; instructions for platforms A, B and C are still used, while the signs for them have been eliminated.
- **Ticket office agents** sometimes do not know which schedule (weekday, Saturday or Sunday) is operated.
- **Stairways** are full with trash, doors are broken, difficult to push.
- **On the platform a passenger has no information whatsoever**, except for voice announcements; he/she cannot check which platform, track or stopping location is correct, nor which train is coming; this is further aggravated by train signing which is generally incomplete, nonexistent and even incorrect. Thus the passenger coming when the train is in the station may step into a train signed "Warminster" and end up at the Airport.
- The highly popular **Trenton-New York connection** (among the people who know

about it) has no special information about R-7 trains and transferring in Trenton. Signing for the Airport Line are similarly inadequate.

At the time of this report writing (July 1993), preparations are being made for giving out contracts to finish the renovation of this station. At the time of finalizing this report (May 1994) the above listed deficiencies continue to exist, and the stairways to the platforms are even more constrained.

Recommendation 3.4

Make sure that the contract for completion of SEPTA's portion of the 30th Street Station includes correction of the numerous deficiencies in the infrastructure.

Recommendation 3.5

Regardless of this contract, at least some of these problems should be corrected immediately, because they do not require major investments, but they are highly damaging to the system reputation and passenger attraction.

The fact must be borne in mind that 30th Street Station not only serves about 30% of all Regional Rail passengers, but it is the location where the greatest number of new passengers use the Regional Rail System for the first time. This is also the location where SEPTA loses the greatest number of potential passengers by the lack of user-friendliness cited above.

OTHER SHORT-TERM IMPROVEMENTS

Through the work on several projects focusing on SEPTA's Regional Rail System in recent years, numerous technical analyses, discussions with SEPTA management personnel, as well as observations in the field have led to the conclusion that there are a number of deficiencies which could be corrected through short-term low-cost measures.

Above all, training and capability of personnel and the entire working environment play a crucial role in the efficiency and effectiveness of the system operations. This section presents a number of different possible changes on the Regional Rail System which, if implemented, could result in very desirable increases in ridership and operating efficiencies. The improvements are presented here in several functional classifications.

4.1 Fares

4.1.1 Intra-Suburban Fares

One of the major problems in the operations and economics of the Regional Rail System is the pattern of trips it serves. Vast majority of trips are to and from the three CBD stations. Increasing intra-suburban ridership is highly desirable because it would attract new customers and generate new revenues with virtually no additional cost. Presently the minimum intra-suburban fare is \$2.00 if purchased in the station. One can argue that due to the high quality service this fare is not excessively high compared to regular transit fare of \$1.50. However, for short intra-suburban trips the high riding comfort is far less significant than for regular commuters who spend 30-45 min each way in the train. On the other hand, the very long headways represent a major inconvenience in using Regional Rail in the suburbs where automobile competition is very strong. It would therefore make sense to reduce intra-suburban fares in order to attract additional ridership.

Latent riders in suburban areas are largely teenagers, students and elderly who are not as interested in high speed as they are sensitive to high fares. These potential riders should be attracted to the system by lowering the fares. Since there are very few intra-suburban riders

now, revenue loss from giving them reduced fares would probably be lower than the additional revenue (and virtually no additional cost) from the newly attracted riders. The western section of R-5, Paoli Line, is the only one with substantial intra-suburban travel, and impacts of this change should be carefully analyzed for that line.

Recommendation 4.1

Reduce the present intra-suburban fares by \$0.50 to \$1.50 and announce this change widely.

4.1.2 Preparation for Self-Service Fare Collection (SSFC)

Fare control and collection by train crew members represents a major portion of their duties. This activity, in combination with door control, dictates crew sizes (many 2-car trains are operated by 3-person crews!), increases train operating costs and constrains options for fare types and methods of their control. There is no doubt that SSFC must be introduced on the Regional Rail System in the foreseeable future for economic and operational reasons. This innovation is described and recommended in the companion report "A Plan for SEPTA's Regional Metrorail System". Consequently, all changes to the fare collection system should be directed toward the future transition to the self-service procedure for the entire system.

Recommendation 4.2

Analyze the problems that have been encountered with Autelca machines. Utilizing experiences of transit systems in this and other countries which have successfully operated such machines (San Diego Trolley, Virginia Express), plan introduction of stationary fare collection machines and simple on-board cancellation machines. Plan implementation of a fare system where passengers can purchase tickets off-board and cancel them on-board. Consider purchase of simple fare collection machines which can be installed on-board as an alternative method for SSFC. In either case, crew members need only scan the paid tickets, rather than issue and punch them. The scanning can be done on a spot-check basis, thus practically eliminating the fare collection duty from the crews.

This simplification of fare collection procedure will be a significant step toward reduction of crew sizes, and thus of operating costs. Moreover, such introduction of the SSFC will permit a greater flexibility in introducing different types of fares by zone, time of day, category of users (students, families, etc.).

4.1.3 Introduction of Intermodal Transfer Fares

One of the factors discouraging potential riders from using the Regional Rail is the fact that for any trip that would involve transfer from Regional Rail to other transit modes, passengers have to pay another initial "base" fare. Since the Regional Rail fares are relatively high, addition of another token or \$1.50 cash fare is for many travelers unacceptably high.

This problem of excessive fares for intermodal travel has been solved for regular riders by introduction of monthly and weekly passes which allow free transfers. However, travelers who make incidental trips still face that problem. For example, a person from Bryn Mawr wanting to go to Sports Complex in off-peak hours would have to pay a 2 x \$3.00 fare on R-5 plus 2 x \$1.50 on the Broad Street subway, for a total of \$9.00. As an out-of-pocket expense this is a very high amount. During the peak hours, the total fare would be \$1.50 higher.

Introduction of a standard \$0.40 transfer charge for trips between Regional Rail and other transit modes would most likely have a positive impact on SEPTA's revenue because it would attract sufficient number of new trips to offset the loss of full fares paid by the transferring passengers on the regular transit lines.

Recommendation 4.3

Introduce regular \$0.40 transfers for intermodal travel between Regional Rail and regular transit modes.

4.1.4 Special Fares for Students and Groups

Under continuing financial pressures on SEPTA there has been a tendency to eliminate special fares for groups traveling together, for students, tourists, etc. However, in view of the greatly underutilized capacity on the Regional Rail lines during off-peak hours, there should be a renewed effort to capture riders by various fare incentives. Following a debate of several

years, the daily pass aimed primarily at tourists has been introduced, tapping a new market of tourists, which with adequate marketing may be rather substantial. There are several other incentives of this kind that should be tested.

Many students who would consider residences in the vicinity of the Regional Rail stations do not choose this option when they are faced with very high cost of monthly passes or the high cost of incidental trips (a round trip to the Center City costs \$5 to \$8). Reduced monthly passes issued to students on the basis of a certificate of their status should be considered.

Travel by groups such as clubs, tourists, and, particularly, organized school trips which often consist of a hundred or more persons, used to be frequent on the Regional Rail System. For various reasons, this market was virtually completely lost, but in recent years, SEPTA has made some effort to recover this loss. Yet, at the present time, the incentives offered are not strong enough and potential users are not actively invited or assisted in finding the best arrangements.

Introduction of special fares, publicity and simplification of arrangement for group travel should be undertaken.

Recommendation 4.4

Introduce monthly passes for students with reduced fares on the Regional Rail System.

Recommendation 4.5

Introduce strong incentives for group travel on the Regional Rail System during off-peak hours by offering special fares, good publicity and simple arrangements. The goal should be improved utilization of excess capacity through attraction of additional riders and revenue generation, particularly during off-peak hours.

4.2 Stations

4.2.1 Lightly Used Close-in Stations

A number of Regional Rail stations in the "ring" area around Center City have represented a major problem to SEPTA for a number of years. Their utilization has been

extremely low, well below the volumes that justify stopping of trains. Yet, reducing services to portions of the city area is a wrong policy from the transportation planning point of view. Moreover, their closing is undesirable due to political and social considerations.

This dilemma between operational efficiency and social/political considerations and needs should be resolved in a constructive manner. A major effort should be made to attract additional ridership at these stations. If this effort generates substantial new ridership, stations should be upgraded and kept in operation. If the effort results in no significant ridership increases, the stations should be closed and efficiency of train operations on the respective line would be improved.

Recommendation 4.6

Undertake a serious effort to increase ridership at presently lightly used inner-ring stations. This effort should include the following measures:

- **Decrease fares to the level of transit fares in the respective areas;**
- **Increase frequency of service at these stations primarily by reducing express operations through them; do not eliminate weekend service (maintain them at least as flag-stop stations).**
- **Accompany these improvements by extensive information on travel and transfer possibilities (such as the intersecting of Green Line 13 and R-3 at 49th Street);**
- **Promote and market these service innovations.**
- **Evaluate the results after one year. Improve stations which have generated appreciable ridership, close the stations which remained with negligible ridership.**

A criticism of the suggestions to increase ridership from these stations might be that new passengers would be added to the maximum load sections of the lines, so that the additional train capacity would be needed, increasing operating costs. This problem can be avoided by not providing additional seated capacity. Most of these trips would be short (5-15 min), on which passengers can stand when seats are not available. However, conditions for standing on the train should be improved by adding stanchions.

Recommendation 4.7

Retrofit the existing rolling stock with stanchions at appropriate places which facilitate standing of passengers.

4.2.2 Civic Center and Eastwick Stations

The Airport Line, R-1, presently offers an excellent service (regular 30 minute service, high speed, comfortable cars), but it is greatly underutilized. One of the major reasons for this underutilization is that the line serves only three Center City stations and three stations inside the Airport. Its extension to Warminster, combining R-1 with R-2, somewhat increases the number of points which R-1 serves. However, the line passes several areas with potential ridership without stopping. This is partly a consequence of a philosophy dominating transit line planning in the 1950's and 60's, according to which trains serving airports cannot have intermediate stops because airline passengers would be delayed and irritated.

This philosophy has been proven wrong. Air travelers put much greater value on reliability of service than on travel time. Rail lines offer high reliability and their travel time is not greatly affected by stopping at several stations between Center City and the Airport. The best proof for this is the rapid transit line extension to O'Hare Airport in Chicago. Opened in the early 1980's, this line has many stations, and yet it attracts very high ridership. Its ridership attraction can be attributed mostly to its high service frequency, the large number of stations, and many possibilities for transfers to/from other modes.

Extensive planning has been done in Philadelphia for a number of years to build additional stations for R-1 between Center City and the Airport. The most advanced has been the plan for Civic Center and Eastwick Stations. Studies show that the Civic Center station would allow access of many traffic generators, such as the Civic Center, the University of Pennsylvania, the University Museum and the Hospital complex, to the Regional Rail System. The Eastwick station would provide access for a sizable residential area and facilitate feeding of the R-1 by walk-in traffic, several transit routes, and by park-and-ride.

Since both of these stations would be very significant for increasing the R-1 ridership, their construction should be given a very high priority. A coordinated effort by several involved agencies (including SEPTA, the City's Office of Transportation, Philadelphia City Planning

Commission, PennDOT and others) should be made more efficient and effective. Moreover, both stations, particularly the Civic Center station should be designed functionally, avoiding excessive architectural and engineering "frills" - elements which lead to overdesign.

An example of administrative inefficiency combined with overdesign is the fact that there is still discussion about the standard once set forth by SEPTA that all station platforms at the Regional Rail stations should be long enough for 6-car trains. Although SEPTA officially does not have that standard any more, there are still persons within SEPTA who claim that such network-wide standards should be maintained; and there are those outside SEPTA who blame this abandoned standard for the delays in planning and for major cost escalations.

Recommendation 4.8

Undertake all necessary actions to expedite the construction of the Civic Center and Eastwick stations. Clearly announce the standards for design of these stations. These should be based on the recommendations from the report "A Plan for SEPTA's Regional Metrorail System". For example, for Eastwick station should have platform length for 2-car trains only.

4.3 Operational Practices

Train operations can be significantly improved through a number of changes in operating practices. First, crews should perform some operations more efficiently than they do now. This includes opening of all doors at stations with high level platforms and as many as possible at low platform stations; more active intervention by the crew at times of delays; active crowd control at peak times through appropriate directives to the public, station announcements performed by the engineer; and, a stronger feeling by the crews of the importance of maintaining the schedule, particularly in times of delays, track works, storms and other emergencies.

The best indication that the present operations could be improved and travel speeds increased is the fact that the present schedules in many cases have longer travel times than the schedules from several decades ago, when rolling stock had lower performance in acceleration, maximum speed and braking. Clearly, a significant factor in determining travel times is not so

much technology, but organization of operations and "mentality" of train crews.

4.3.1 Train Operations at Stations

Presently, the crews seldom display an attitude of expeditious behavior, fast actions and awareness of the importance of service speed, punctuality and reliability. This relaxed attitude is partly encouraged by "generous" schedule times. The result is that on some sections trains now have 6-8 minutes longer travel times than 20 or 30 years ago (during the same period the competing highway travel times have been drastically reduced). On some express runs the schedules allow such long standing or "slack" times, that expresses save very little time to passengers, while not serving the stations through which they pass without stopping. This has considerably decreased the usefulness of express operations.

Lack of destination signs on most of the cars, often along the entire train, or incorrect signs (e.g., "Secane Express" goes to Elwyn; it only does not stop to Secane!) sometimes cause confusion: if a conductor is not standing at a door, a passenger arriving while the train is in station does not know whether he/she should board it or not. This sometimes delays train departures in the three Center City stations - the most critical ones for operating speed and reliability of the entire network operation.

Recommendation 4.9

Increase efficiency of crew operations by such improvements as:

- **Introduce and strictly implement the rules that train crews must open all doors which they can handle and supervise;**
- **Improve crew training to handle crowds and undertake decisive corrective measures in cases of delays;**
- **Fully implement and ensure practicing of the rules for placing designation signs at all doors and at the head of the train at all times.**

Recommendation 4.10

Reduce present crew sizes on a number of trains through the above mentioned simplification of fare collection, training for handling of emergencies, operation of

the public address system by the engineer, and similar measures. Use the savings from smaller crews to offer higher frequency of service.

Recommendation 4.11

Increase intermodal transfers between Regional Rail and other modes (rapid transit, bus, trolleybus, and streetcar lines by improved information, particularly at stations, by coordinated scheduling, transfer fares and overall marketing.

4.3.2 Service Reliability and Scheduling

One of the best achievements of SEPTA's Regional Rail Division in recent years has been a noticeable improvement in the reliability of its services. The riding public today recognizes that Regional Rail trains operate with high reliability.

In general, reliability of service can be improved, among various elements, through the use of "cushion times", i.e., adding several minutes in the schedule, so that small delays can be absorbed and the train still keep on schedule, or by improving efficiency of operations. The present schedules have very "generous" cushion times, which cause many more problems than benefits. First, they cause noticeable increases in travel times (travel into Center City is now considerably longer than several decades ago) and make service less attractive compared to the automobile. Second, they reduce scheduled speed and thus increase operating costs. Third, slow travel on the joint section causes propagation of delays among trains (for example, if a train enters 30th Street Station 3 min early and has to "kill" that time, it will delay a train on another line which is running on schedule). And fourth, addition of cushion times to the 30th Street-Market East section **delays the vast majority of passengers on all their trips**. Although the cushion times help reliability by "absorbing" some delays, the described problems represent a high and usually unnecessary price to pay for that. Moreover, as mentioned above, it is not uncommon that trains leave outer terminals late (extend their layover times) knowing that they can recover the delay using the cushion time. This practically defeats the purpose of providing cushions and simply decreases attractiveness of services.

Three corrections are recommended. First, train travel through the central section, 30th Street-Market East, should be speeded up considerably. At stations, trains should not be

standing that conductors answer passengers' questions: the information system should provide that. Crew changes at these stations add variable delays. There is also no reason that the trains go from Penn Center to 30th Street Station at 15-20 mph. For most trains at least 1, possibly 2 min can be cut out of the schedule for that section.

It should be borne in mind that delays on this core section of the network reduce its capacity. Therefore, if the number of trains that have to traverse this section has to be increased, the present operation has elements which would allow improvements.

Second, cushion times should be retained for lines with low reliability (mostly the Amtrak-dependent lines, like R-1 and R-2 inbound directions; it should be reduced to 1-2 min on all other lines. And third, the cushion times should be used prior to the line convergence points.

The high reliability can be maintained by additional crew training which will result in improved precision of operations, reduced incidence of delays, and faster schedule recovery when delays do occur, as discussed above.

Recommendation 4.12

- Expedite train processing at the three Center City stations and speed up train travel among them: standing times should be reduced and running speeds increased, so that the scheduled travel time between Market East and 30th Street Station is shortened from 9-10 min at present to 7-8 minutes.
- Improve control of departures from outer terminals to prevent the tendency of crews to extend layover times and then using the slack time to still arrive in Center City on schedule.

Recommendation 4.13

- Drastically reduce cushion times on all lines except those which have frequent delays, such as those dependent on Amtrak schedules (e.g., inbound R-1 and R-2). wherever possible, build the cushion times before the points of line convergence.

One aspect in which service reliability of Regional Rail is not yet satisfactory are

operations in inclement weather and other adverse situations. Actually, high service reliability is particularly important during snow storms and other inclement weather conditions not only because its riders need it under such conditions, but also due to the fact that many other travelers who do not use Regional Rail regularly turn to these services on such occasions. It has been experienced in many cities that when new riders came under emergency situations and found reliable transit service, a large portion of them stayed with the system as its permanent users.

For example, ridership on BART increased from 210,000 per day prior to the earthquake of 1989 to 350,000 after the earthquake when no alternative transportation existed; then it decreased only to 260,000 when all other facilities were reopened. Thus, BART ridership permanently increased by 25% due to the reliable and convenient service offered during the emergency situation.

During the harsh winter of 1993/94, SEPTA's Regional Rail performed remarkably well and on several days its lines were virtually the only regional transportation functioning in the Delaware Valley. This was a good proof that the system can provide reliable service under adverse conditions. The only criticism is that its Public Information Office did not use this opportunity to take credit for this remarkable achievement, build up public image and attract many new riders, many of whom would later stay with the system.

Recommendation 4.14

Continue efforts to increase Regional Rail service reliability by training the crews for handling emergencies and adverse conditions, elaborating contingency plans and improving effectiveness of the control center supervision and operations. Increase publicity for services in emergency situations (snow storms, icy roads, heavy rains, fog, extreme heat, taxi strike, etc.) when Regional Rail is clearly and visibly superior to the alternative of driving.

Another aspect of service reliability from the passengers' point of view is that in the case of any delays, passengers should have a way of finding out what the problem is, so that they can decide to make appropriate decisions - wait, search for alternate transportation, or postpone the trip.

Recommendation 4.15

Introduce a telephone number with passengers information on the current service disturbances.

4.3.3 Improvements in Speeds and Headways

SEPTA has recently upgraded speeds on several lines (R-3 West Trenton, R-6 Norristown and Main Line as a part of Railworks). The Elwyn branch of R-3 is also undergoing improvements at present. Running speeds are being increased from 50 to 60 mph (80 to 97 km/h). Further upgrading is planned for R-2 Warminster (increasing speeds over grade crossings from 5 to 50 mph (8 to 80 km/h)), R-8 Chestnut Hill West and other lines.

Equally significant has been introduction of shorter headways (from 2 hrs to 1 hr) for Sunday services on several lines.

These improvements have had an excellent response demonstrated by significant increases in ridership. Such efforts are commended and they should be continued.

4.4 Information and User Friendliness

In recent years SEPTA has made significant efforts to improve information about its services for its present and potential riders. The Regional Rail System, being now integrated through the Center City tunnel, has a much stronger image as a unified regional network. Yet, there is a need for further improvement of the information system. A few examples of particularly serious deficiencies are listed here.

A major problem of inadequate information (or total lack of it) is in the signing of stations on Center City streets, as well as in some suburban areas. For example, if a person walks along Market Street from the 7th to 12th Streets, he/she would be passing in the immediate vicinity of a large, most attractive transit station in the Philadelphia Region, the Market East Station, without being aware of that. No major, clear sign on that street designates that important station. In the evening hours the problem of finding the station is even greater because all entrances on Market Street are closed and passengers must go around one or two corners to find an open entrance in the vicinity of the Greyhound Terminal.

Recommendation 4.16

Designate clearly the Market East Station and mark all entrances to it, including "all-time" entrances, those open after the Gallery is closed.

The largest transportation terminal in the Center City of Philadelphia, the 30th Street Station, has similarly inadequate signing for SEPTA's stations and services. The recently installed kiosks with maps and schedules are very valuable and frequently used, but they are not sufficient. The following problems remain:

1. Persons arriving to Philadelphia for the first time (who should be used as the "design persons" for transit information and marketing) do not get a full, easy picture of the possibilities of travelling throughout the city and region by transit. The kiosks show the Region and have schedules of individual lines, but they do not show how one can use SEPTA to come to Center City (City Hall, Historic Area, business area west of the City Hall, Market East, shopping areas, etc.). Actually, the Mantua area is shown, but not the Center City.

2. Information on fares and the Daily Pass is not easily available.

3. Locations of the stations within the 30th Street complex themselves are difficult to discover. It is a regular phenomenon to see persons in the south-west corner of the Station looking for the 30th Street Subway Station.

To further aggravate the problem of inadequate information, some stations have confusing names. In the 30th Street Station signs directing passengers refer to "Commuter rail", "Commuter trains", "SEPTA trains" and "Regional Rail" - all for the same facility and service.

Approaching SEPTA's Regional Rail Station on the upper level, passengers are not shown which stairway, left or right, they should take to the platforms A, B and C. The five years of "temporary" facilities, broken doors, boarded up escalators with dirt around them, no signs on the platforms, trains stopping randomly at the first or second stairways forcing confused passengers to rush along the platforms - are not only a major inconvenience and cause of delays; more importantly, they give passengers a distinct impression of neglect.

While installation of fully integrated, logical and modern information system takes some effort and requires investment, removal of signs with obsolete names and prevention of installations of new signs with incorrect information should be feasible: it requires no funding.

The information about travel that involves two different Regional Rail lines, such as Fox Chase to Chester, could be explained to the public more clearly than is the case now. Furthermore, information on intermodal transfers between Regional Rail and other transit modes is in many cases inadequate or non-existent. The important connection between Regional Rail and the Blue and Green Lines at 30th Street Station is still very poor.

As a result of these deficiencies, a large number of potential customers of SEPTA's Regional Rail and other services (and revenues from their fares) are lost to taxis and other modes.

Financing for information signs is often a problem. However, in some cases, such as the Amtrak/Regional Rail/Blue Line and Green Line interface at 30th Street Station, the situation is such that a substantial investment in adequate signing would most likely be quickly recovered by additional fares from the newly attracted passengers.

A new problem has been created during the past year: printed schedules have been revised so that they now:

- Separate the integrated Regional Rail network (many lines have two completely separate schedules, hiding the fact that there is through service! For the lines with many stations which cannot be printed legibly, schedules which cover one of the two branches must have at least the 2-4 key stations from the other branch. It is not acceptable that any schedule does not indicate both terminals.

- Provide different line numbers for the same services and the same number for different services (lines R-1 and R-2 is the case in point. Several schedules create the above defined confusion which even SEPTA employees cannot explain).

- Instead of using information to increase utilization of through services and transfer possibilities, the present schedule practically hide these possibilities.

- The new document "SEPTA's Guide to Regional Rail Travel" is a very valuable pamphlet. It does not, however, eliminate the need for each schedule to have all basic information for one line.

Recommendation 4.17

Implement the suggestions developed at the Symposium on "User-Friendly Services", sponsored by SEPTA in October of 1989.

Recommendation 4.18

Facilitate integration of the Regional Rail with the Blue/Green Lines, and both with Amtrak, by clearly designating the paths among the three stations at the 30th Street Station.

Recommendation 4.19

Immediately correct the schedules to show the Regional Rail network integration and possible transfers and corresponding fares, rather than hide these possibilities and provide confused schedules. Each line must have a clear designation and show the entire runs, rather than only one half of them. The great efforts to improve regional travel, started with the opening of the Center City Tunnel in 1984, should not be destroyed; they should be strengthened.

4.5 Marketing the Regional Rail System

The passenger, particularly an out-of-town visitor to the city, should be the "design person" for the information and marketing systems. Therefore, the information system must be designed for and evaluated from the point of view of its users, i.e., present and potential passengers.

The first, basic task of marketing should be to create a clear, positive image of the Regional Rail (and other transit) services. With the omnipresent competition of heavily subsidized automobile travel, SEPTA must aggressively present its services. This is particularly important for out-of-town visitors who may be "captured" by SEPTA's services for their entire stay in the city, or lost to the competition.

Marketing and information must attract attention of potential customers and give them clear information about the available services and ways to use them.

Recommendation 4.20

- **Develop a convenient slogan for the system, such as:**

"Regional Rail - trains to 164 points in 3 states, 7 counties of the Philadelphia Region";

- **Present this slogan at all major stations, particularly at 30th Street Station and at the Airport, for out-of-town visitors.**

4.5.1 Special Event Services

SEPTA correctly attempts to provide extra service for special events, but it often does that in an inefficient manner. For example, on "Super Sunday" the regular Sunday services with 2-hour headways (!) were maintained, but 2-car trains were replaced by 4- and 5-car trains. On some trains 4-person crews were given. Since the 2-hour service (predictably) could not attract crowds, frequently only 1 or 2 cars were opened, with crew members getting in each other's way. A very substantial useless car-mileage is operated.

Greater frequency is much more important for attracting special events crowds than ample seating capacity. Departures at convenient times is what attracts the riders; if the cars are full and even if there is standing, this is not a problem with the typically jovial mood of such crowds. The impression is even positive -that all categories of people - families, students, youth, seniors, not only commuters - like to use SEPTA's trains!

In designing and advertizing special event services, it must be borne in mind again that they should be tailored for occasional or new riders. Therefore, convenient information for all trains should be published, instead of "supplemental trains" separately from the regular ones. Passengers should not have to consult two different schedules and try to "merge" them.

Recommendation 4.21

Services for special events should primarily consist of greater frequency (shorter headways), rather than longer trains; train consists should be increased only if major crowds are expected, but it is not essential to provide excessive seating capacity typical for daily off-peak services.

Measures should be undertaken to provide ability to issue many tickets in a simple

way, to prevent excessive manual collection with complicated punching in on-board ticket purchases. Such procedures often cause either service delays or failure to collect revenue.

4.5.2 "Wednesday Special"

A regular discount travel on one weekday is a proven successful marketing tool, because it attracts many occasional riders to the system.

The writer of this report proposed in 1981 introduction of a "Wednesday Special" - that on Wednesdays round trip tickets would be sold for one-way ticket price. Another possibility would be that many merchants in the city would validate their customers' Regional Rail ticket for a "free" return trip; then SEPTA would obtain a reimbursement from the merchants. At one time the Chamber of Commerce found considerable interest among downtown retail establishments, but implementation has not been materialized so far.

The special discount on Wednesdays which SEPTA introduced a few months ago is similar to the "Wednesday Special", but with one difference. The introduced discount is deeper than was proposed for the "Wednesday Special", and it is absorbed by SEPTA. With the new competition of free parking in the Center City on Wednesdays, SEPTA's revenues have been reduced.

Recommendation 4.22

Revise the present \$1.00 ticket on Wednesday to "Round trip for one-way fare". Explore with the Chamber of Commerce further promotion with participation of downtown merchants. Negotiate with the City government that no free parking is provided in the areas served adequately by SEPTA. Transit should be favored, rather than disadvantaged by Center City promotions.

4.6 Improvements of R-1 and R-7 Lines

In addition to the measures proposed for increasing ridership on the entire Regional Rail System, two lines are exceptionally underutilized at the present time and they deserve special attention: the Airport Line (R-1), and the Trenton - New York connection (R-7).

4.6.1 The Airport Line

This line has suffered from low ridership, largely due to lack of information and marketing, since its opening. Paradoxically, the City, which had invested a significant amount of funds in its construction, allowed for many years taxi and other lobbies to prevent SEPTA from providing even the basic information about the Airport Line at various locations throughout the Airport and Center City.

When SEPTA was finally allowed to put large designation signs in Airport corridors passing over the stations of the R-1 line, those signs were not only modest by their meaning, but actually deceiving: "Trains to Center City"! What these signs announce, does not give potential riders any idea that they can use this line to get conveniently and cheaply to Paoli, Warminster, Temple - some 164 stations throughout the Region. The Regional Rail System covers most major corridors in the five counties (the only major exception is the West Chester Pike corridor), as well as several points in Delaware and New Jersey. Persons coming to Philadelphia for the first time should be informed about that.

Recommendation 4.23

Develop a system of complete and correct information about the Airport Line, pointing out that:

- **It connects the Airport with 164 stations throughout the Region (see Recommendation 4.20);**
- **It runs every 30 minutes throughout the day;**
- **It is reliable and comfortable;**
- **Its fare is far lower than prices on all competing modes, such as taxis and limousines (quote fares to such key points as Jenkintown, Paoli, Trenton and others).**

The recent connection of R-1 with the northern portion of R-2, to Warminster, at certain times of day, has improved connectivity of R-1 and provided the valuable direct connection between Jenkintown and the Airport. The problem is, however, that this change has been made "internally", not considering the requirements of the public to have clear information and image

about the services. Thus, there is no clear information what is now R-1, what is R-2, which schedules passengers should use (the same trains are announced on two different lines), etc.

Recommendation 4.24

Clarify the relationship between R-1 and R-2 and present to the public clear information for each one of them. If the lines are combined, show them so: people can understand that better than listing the same trains on two supposedly independent lines.

Recommendation 4.25

In cooperation with the City, consider how the Line could attract more Airport employees. For example, the stimulus created by the Clean Air Act should be used to introduce charges for employee parking, and then have the Airport contribute that revenue to enable possibly 20-minute headways on R-1, to the benefit of all user categories; pricing of Trailpasses can be changed to make them more attractive to employees; or, instead of free parking, the Airport should give their employees some "transportation allowance" which they may use for paying either parking or for a Regional Rail Trailpass, etc.

Recommendation 4.26

Develop a marketing plan for R-1 with new ideas, such as:

- Information about R-1 should be included in every "welcome package" and other information about Philadelphia. This is particularly applicable to the information about the new Convention Center;**
- Point out how much cheaper and more convenient it may be for travelers from Trenton to use the Philadelphia rather than Newark Airport.**
- Consider including a reduced train fare in air fares and promotion of airlines' flights to Philadelphia.**

4.6.2 The Philadelphia - New York Connection

The present SEPTA-NJT connection between Philadelphia and New York is literally an untapped gold mine which both of these agencies have largely ignored and virtually kept hidden.

To realize the potential of this service, it is useful to take a look in perspective at its present and potential role.

The Philadelphia-New York City pair is probably the most intensively traveled corridor in the country. How is that travel performed?

- Air travel is used mostly for connecting flights - from PHL to other locations via JFK. For trips between Philadelphia and Manhattan air travel is practically useless because of the remoteness and complexity of the JFK Airport. La Guardia is only slightly better.

- Bus travel exists, but it is much slower and less comfortable than rail; it serves mostly corridor trips for many points between Philadelphia and New York.

- Auto travel also has many obstacles: congested and hazardous highways (12-lane New Jersey Turnpike, the tunnels and bridges across the Hudson and Delaware), extremely high parking prices. Yet, due to the very low out-of-pocket cost of auto travel (10-20% of its total cost and no charge for social costs) and various subsidies of this mode (expenses tax deductible or paid by firms, government agencies, etc.), this mode carries the largest volume of travel. Even car rentals are in some cases price-competitive with various public transport modes, such as air and rail - an absurd situation.

- Amtrak offers frequent and very good service, but at a very high price. With a round-trip fare of \$48, Amtrak is not price-competitive with the marginal (out-of-pocket) cost of the automobile. Therefore, all price-conscious travelers try to find other alternatives. Such groups are quite large; they include families, students, groups traveling together, elderly, etc.

- **The SEPTA-NJT connection offers generally hourly service which takes 30-45 minutes longer than Amtrak and requires transfer in Trenton; but the price is less than half of the Amtrak's price.**

Consequently, for large numbers of passengers this is a very attractive service. Potentially, it should be able to attract a much greater ridership than it now has.

Why aren't SEPTA's R-7 and NJT's NE Corridor trains filled with these riders? The main reason is that **this service is practically hidden and very little has been done to attract**

this large potential ridership. Virtually the only way potential travelers can learn about this service is by discovering a footnote-type NJT schedule from Trenton to New York at the bottom of the R-7 schedule.

It is obvious that there is a great demand for a reasonably good and very economical public transport service between Philadelphia and New York, as well as the many intermediate points (Newark, New Brunswick, Princeton, Trenton, Levittown, Torresdale and others). SEPTA and NJT should carefully consider the present deficiencies of their joint service, such as:

- No easy way for potential riders to "discover" the service and learn about its details - schedule, fares, stations;
- Through ticketing for the northbound travel is available only from one machine at 30th Street Station;
- Uncertainty how to make the transfer in Trenton (same platform or not, is it possible to purchase the NJT ticket, is there a penalty if purchased on the train, etc.);
- Uncertainty whether the connection will be made or missed if a delay occurs;
- Slow and complicated SEPTA's ticket purchasing in Trenton, sometimes due to waiting lines, malfunctioning Autelca machines, etc.
- No easy information about transfers and joint tickets for travel from other Regional Rail line destinations, such as from the Airport, Bryn Mawr, Media or Jenkintown.

Most of these obstacles can be resolved with short-term very low cost improvements.

Recommendation 4.27

Develop an action plan that will resolve most of the above listed deficiencies, such as:

- **Give an attractive name to this service ("The Corridor Connection", "The Frequent Rail Flyer", "The New York-Philadelphia Rail Shuttle") and advertize it extensively to give it recognition and image;**
- **Publish a joint SEPTA-NJT schedule for this service with complete schedule, fare and operational instructions for passengers;**
- **Introduce easy purchases of through and round-trip tickets, family and group**

fares;

- **Appoint a person, jointly with NJT, whose specific duty will be to facilitate transfers of passengers between SEPTA and NJT trains; he/she should direct passengers, inform and assist them in finding schedules, purchasing tickets, etc. In the case of crowds, this person should find the best way to assist the train crews in issuing dozens if not hundreds of tickets during the train travel; control of payments would also be greatly improved.**
- **Reconsider the possibility of through-routing of SEPTA's and NJT's trains during off-peak hours, which could not be arranged a few years ago;**
- **If a significant ridership growth occurs (which is very likely), consider increasing the service frequency and, with 30-min. headways, operating some type of skip-stop services. This would mean that lightly used stations would continue to have 60-min. headways, major stations would get twice more frequent service, and the speed and quality of service would be increased, thus further attracting new ridership.**

The Philadelphia-New York "Shuttle" is definitely an underutilized service with great potential. If SEPTA wants a significant success in attracting new ridership in a short-run, without major investments, this is certainly such a project.

4.7 Planning for the Future

The plan for long-range upgrading of the Regional Rail System, "A Plan for SEPTA's Metrorail System", submitted to SEPTA by this team in May 1993, has detailed analysis of many system elements, such as fare collection, platform design, station operations, etc. Although this Plan is still under review and evaluation by SEPTA, many of its analysis can be used immediately for analyzing and improving operations, maintenance, design and repairs at the present time. It is suggested that these analyses be carefully reviewed and used in upgrading present standards and practices.