Train Crew Reduction for Increased Productivity of Rail Transit

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Labor costs have become the dominant portion of operating costs for transit agencies. Efforts to increase productivity of operating labor have been particularly successful on rail transit systems. For example, development of high-capacity articulated cars, provision of separated rights-of-way, and introduction of self-service fare collection have resulted in an approximately 20-fold increase in productivity of light rail transit systems. Possible methods for reducing train crews on existing systems that have obsolete operations are analyzed. Their implementation is shown to be feasible and, in many cases, not necessarily complicated. It is shown that although the recently built rail transit systems (e.g., Lindenwold Line, San Francisco's Bay Area Rapid Transit, and Atlanta's Metropolitan Atlanta Rapid Transit Authority) have one-person train crews and thus high productivity, most older streetcar, rapid transit, and regional rail systems still have obsolete and inefficient labor practices. A systematic analysis shows that, on many existing transit systems, the productivity of operating labor can be substantially increased through modest efforts. The greatest potential benefits from the introduction of modern operating methods exist on regional rail systems and, to a lesser extent, on existing rapid transit systems. Cooperation of labor unions should be obtained by retaining jobs through increased service frequency or by passing on a portion of the savings to the operating employees in the form of increased wages for increased duties.

The focus of this study is on the labor productivity of rail transit operations. Rail systems have the potential to achieve a high level of labor productivity through the use of modern operating practices. High productivity translates into either low costs for a given volume of transit service or large volumes of service provided for a given cost.

Still, in the United States, one can find a wide range of practices: from a one-person crew per 10-car rapid transit train [Bay Area Rapid Transit (BART)] to a three-person crew on 3-car trains of short streetcars, or, until recently, on 4-car rapid transit trains (both in Boston).

The purpose of this study is to systematically review the issues that determine crew sizes in rail transit, to review the current practices in different cities, and to examine the possibilities of reduction of train crews, particularly on existing transit systems.

RAIL TRANSIT MODES AND CREW DUTIES

Mode Categories Defined by Transit Unit Crew Sizes

Light Rail Transit

Light rail transit (LRT) is electric rail transit that consists of one- to three-car transit units (TUs) that operate on partly or fully separated rights-of-way (and, in some cases, on streets). Stations are generally unattended, and only manual driving is possible because of grade crossings or street running.

1. LRT-1: There is one crew member (the driver) per TU. The driver supervises fare collection, checks flash tickets, or allows free entry (self-service system). Alternatively, the driver may sell tickets to those passengers without prepaid ones. The driver controls doors, supervises passenger boarding, and announces stations. Vehicles may be large (articulated cars) and, in some cases, TUs may consist of two to four cars.
2. LRT-2: There are two types of systems in this category (a) driver plus conductor, where the driver has no other duty except driving; the conductor controls fare collection, operates rear doors, supervises passenger boarding, etc. (there are no North American operations of this type); and (b) multiple unit (MU) operations, where the driver is in the lead car and an attendant is in each trailing car; the attendants perform all duties for their cars that the driver does for the lead car except driving (such systems normally operate as MUs for part of the day and as LRT-1 for the rest of the day).

Rail Rapid Transit

Rail rapid transit (RRT) includes rail transit systems with fully controlled rights-of-way (category A) and stations; therefore, fully automated driving is theoretically possible. TUs consist of up to 10 cars. All stations are either attended or have automatic fare collection. Fares are collected in stations before the passengers enter the platforms. On-board fare collection is uncommon (e.g., off-peak on some systems). Platforms are high level.

1. RRT-1: The driver is the only crew member. In addition to driving, this crew member controls the doors and can announce stations via a public address system. On a few systems (Cleveland, Skokie in Chicago), fares are collected by the driver. RRT-1 systems are often, but not always, equipped with automatic train control.
2. RRT-2: Crew consists of the driver plus one or more other persons whose main duty is to control the doors. The extra crew member or members may also collect fares at low-volume stations or during off-peak periods.

Regional Rail

Often called commuter railroads, regional rail (RGR) has a great variety of operating characteristics. Their stations can be attended or unattended, but there is usually free access to the platforms. Platform heights may be either all low, all high, or mixed (some low and others high level).

1. RGR-1: In a low-volume operation, the driver may be required to collect tickets in addition to controlling the doors and driving. This category is extremely rare; there are no examples in North America.
2. RGR-2: In this system, there is one driver plus another crew member, who may primarily control doors, collect tickets, or both. Most modern RGR systems operate with two-person crews. Some operate as RGR-2 during off-peak periods when one-car trains are used; at other times (with MU operation), more crew members may be required.
3. RGR-3: In the United States, systems that operate under class I railroad rules often have three or more crew members. Doors are often manual and may have traps to enable operation at both low- and high-level platforms. Tickets are sold either at stations or by conductors. Every passenger is checked for fare payment by a conductor.

The following table summarizes the categories given above:

Basic Mode	Crew Size	Category Designation
Light rail transit	1	LRT-1
	2	LRT-2
Rapid transit	1	RRT-1
	2	RRT-2
Regional rail	1	RGR-1
	2	RGR-2
	3	RGR-3

Definitions of Crew Duties

A detailed examination of operating practices on most rail transit systems, which includes all rail modes, has shown that TU crew members perform a maximum of 17 duties, which are shown in Table 1, and are classified by their applicability to each mode. The list below explains crew members' duties in more detail:

1. Supervising doors. Passenger boarding and alighting can be observed in the following ways: (a) a crew member stands on the platform or looks from a train window, (b) driver looks from the window of the cabin, (c) station attendant, or (d) there is no supervision, but there is a warning for passengers that doors will close and all doors have sensitive edges to prevent catching a passenger. These methods are adequate for all systems with high-level platforms. LRT and RGR systems on which vehicles have high first steps require on-location supervision and assistance to ensure safe boarding and alighting.
2. Closing doors. Manually operated doors on transit (RGR) vehicles are usually not closed after every station. Automatic doors are closed from a single control point or automatically. Closing from a central location comes usually from a driver's cab, either in the first or in some other car. Automatic closing comes after a predetermined standing-time interval. In either case, a voice warning or a buzzer warns passengers before door closing. Thus, door closing can be done by (a) a crew member (nondriver), (b) the driver, or (c) automatic pretimed control.
3. Fare collection. Cash from passengers can be collected by (a) automatic machines that issue fare cards to be used for entrance or to be checked on board, (b) fare boxes or turnstiles, (c) cashiers, (d) crew members, (e) drivers, or (f) prepaid tickets (monthly commuter tickets, passes).

Table 1. Duties of rail transit crew members by mode.

Duty	SCR and LRT	RRT	RGR
Driving	x	x	x
Train inspection			x
Reporting at terminal			x[a]
Coupling and uncoupling	x	x	x
Communications with control center	x[a]	x	x
Announcements	x	x	x
Opening doors	x	x	x
Supervising doors	x	x	x
Closing doors	x	x	x
Moving traps	x		x
Signaling departure	x	x	x
Changing seats			x
Passenger information	x	x	x
Fare collection	x		x
Fare control	x	x	x
Safety and security	x	x	x
Emergencies	x	x	x

Note: SCR = streetcar.

[a]Few applications.

4. Fare control. Fare payment can be checked by (a) automatic gates activated by coins, tokens, or fare card; (b) crew on a regular basis, usually during travel; (c) driver during passenger boarding or alighting; or (d) controllers on a spot-check basis.

In order to reduce personnel, two alternatives are considered:

1. Keeping two-person train crews (typical for older RRT systems) and eliminating station personnel (Cleveland uses this practice during off-peak hours), or
2. Retaining station personnel but reducing train crews to one member (typical for several new RRT systems, such as BART and Washington, D.C., Metro).

The basic factor of selecting between these two alternatives is the number of stations (and their design, which may require more than one station attendant) and the number of trains in operation.

PURPOSES OF TRAIN CREW REDUCTIONS

The percentage of total operating costs going to labor indicates the importance of productivity. In most transit agencies, labor costs have grown to 60 to 80 percent of total operating costs, despite the realization that the financial condition of the transit system could be enhanced by improving the productivity of the operating personnel.

Transit operators in U.S. cities were among the first in the world in the 1930s to introduce one-person crews on all street single-vehicle transit systems: streetcars, trolleybuses, and buses. Several other developments occurred in the meantime that actually decreased productivity in street transit modes. These were

1. Replacement of streetcars by buses with approximately 20 percent lower capacity;
2. Loss of separate streetcar rights-of-way on many lines, which resulted in lower transit operating speeds; and
3. Increased street congestion, which also decreased operating speed.

A drastic increase in rail transit labor productivity occurred only when new RRT systems were built, starting with the Lindenwold Line in Philadelphia. Figure 1 shows transit operating personnel productivity as a function of crew size for the three modes: LRT, RRT, and RGR.

The benefits from reduced crew sizes are basically economic (reduced costs), and they can be translated into the following forms:

1. Reduce the number of operating personnel and maintain the same service. Benefit: reduced operating costs.
2. Retain the same operating personnel but change the crew members released from duties into security officers. Benefit: increased security.
3. Retain the same operating personnel, but split trains into half-size units (e.g., one eight-car train into two four-car trains) and provide service with double frequency at the same cost. Benefit: increased level of service.

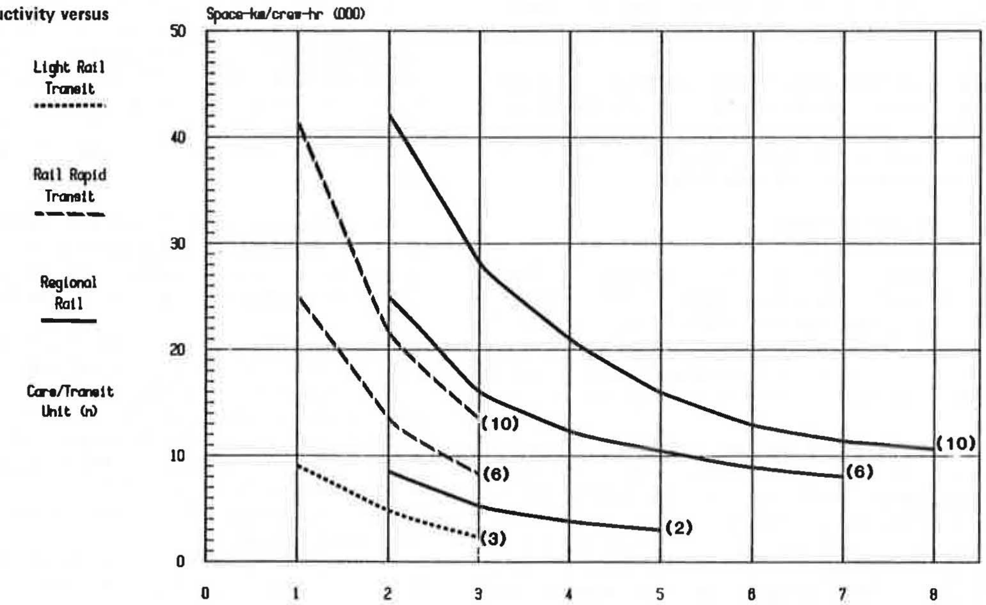
In most cases, a combination of two or three of these benefits is the best solution.

CREW REDUCTION ON LRT SYSTEMS

No transit mode has made such remarkable progress in increasing labor productivity in a span of only approximately 25 years (between the mid-1950s and the late 1970s) as has been the case with streetcars and LRT. A review of LRT rolling stock and types of operation (characteristic for different stages of development) is presented in Figure 2. It should be mentioned that virtually all this progress took place in West European countries; the practice of using longer TUs has had a much longer tradition in those countries than in North America. It has been only in recent years that several cities in North America have adopted the latest advances in LRT system technology and operations from West European countries.

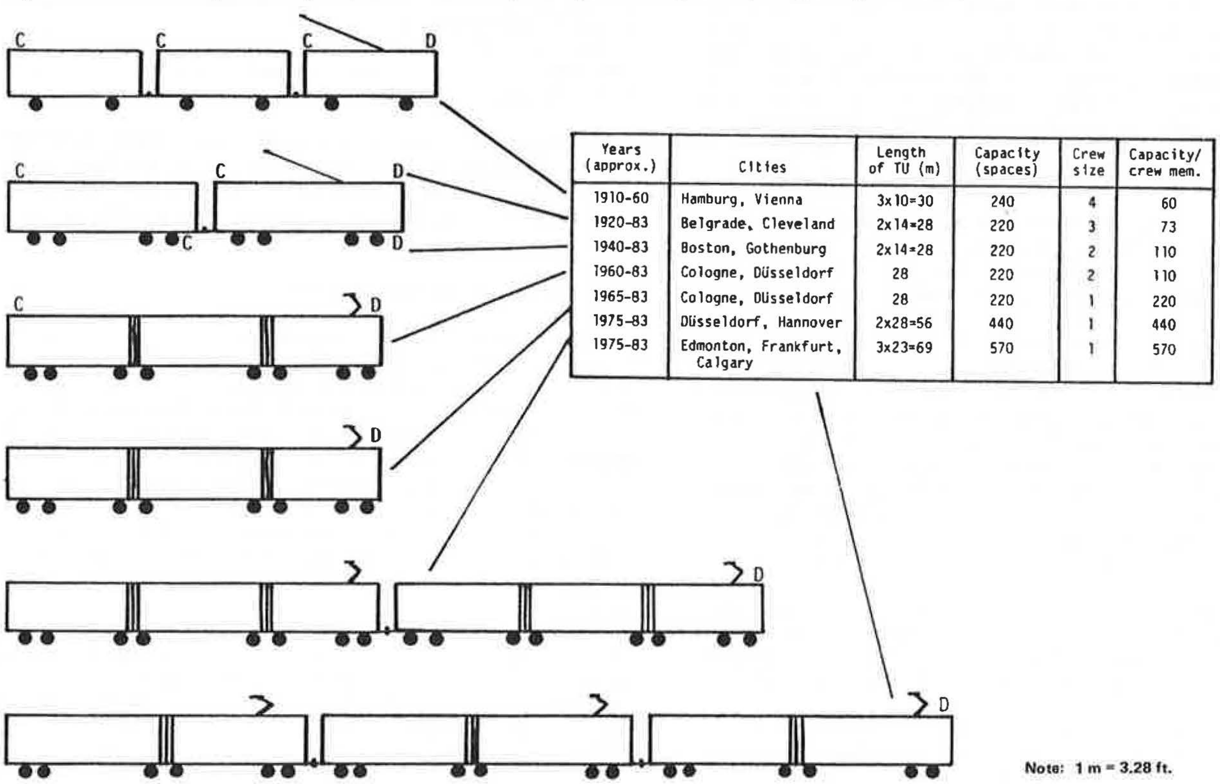
In addition to the development of articulated cars and construction of upgraded rights-of-way, a major breakthrough for LRT labor productivity oc-

Figure 1. Operating productivity versus crew size.



Note: 1 km = 0.62 mile.

Figure 2. Increased labor productivity on SCR and LRT through rolling stock and operational innovations, 1950-1980.



Years (approx.)	Cities	Length of TU (m)	Capacity (spaces)	Crew size	Capacity/ crew mem.
1910-60	Hamburg, Vienna	3x10=30	240	4	60
1920-83	Belgrade, Cleveland	2x14=28	220	3	73
1940-83	Boston, Gothenburg	2x14=28	220	2	110
1960-83	Cologne, Düsseldorf	28	220	2	110
1965-83	Cologne, Düsseldorf	28	220	1	220
1975-83	Düsseldorf, Hannover	2x28=56	440	1	440
1975-83	Edmonton, Frankfurt, Calgary	3x23=69	570	1	570

Note: 1 m = 3.28 ft.

curred in the method of transit operation. During the 1960s, a full self-service fare-collection system on many systems was introduced.

Clearly, all existing systems that operate four-axle cars as single vehicles cannot be made more labor efficient. One driver on each such vehicle is the absolute minimum crew size that can ever be achieved. However, there are two methods by which labor productivity can be increased:

1. Introduction of higher-capacity cars, such as six- and eight-axle articulated ones; this has already been done in Boston, Edmonton, San Francisco, Calgary, Cleveland (Shaker Heights), and San Diego; and
2. Operation of the second and third cars in LRT trains without crews, which would be beneficial for new and existing systems that operate TUs with more than one car, such as Boston, Buffalo, Cleveland, Philadelphia, Pittsburgh, and San Francisco.

CREW REDUCTION ON RRT SYSTEMS

There are two basic types of RRT systems in North America with respect to crew sizes. The systems that were in existence before 1969 have two-person crews: a driver and a conductor. Basically, the conductor opens, controls, and closes doors; signals to the driver; and has no duties during the travel of the train.

The second group of RRT systems consists of those that started operations since 1969: the Lindenwold Line in Philadelphia; BART in San Francisco; Washington Metropolitan Area Transit Authority (WMATA) in Washington, D.C.; and Metropolitan Atlanta Rapid Transit Authority (MARTA) in Atlanta. All of these systems have crews that consist of one person--the driver--who performs all the duties: controls the train (which is in most cases automated); opens, supervises, and closes doors; and communicates with the control center.

The Cleveland rapid transit system, which opened in 1955, applies great flexibility in crew employment. It operates with both one- and two-person crews, depending on the time of day. During peak hours, stations have attendants and trains operate with two-person crews, with the conductor only controlling doors. During off-peak hours, most stations are not attended, with fares collected on trains. Two-car trains have two-person crews, one-car trains have the driver only, who also collects fares.

The major obstacles to one-person operation that will be encountered on most existing RRT systems are visibility of all doors to ensure their safe closing and maintenance of security and public perception of safety.

Following is a case study of the Market-Frankford subway, which is an elevated line in Philadelphia. The Market-Frankford RRT line in Philadelphia has many physical features and operating practices typical of most other older RRT systems. The line is a conventional RRT line with broad-gauge track, which operates on an elevated structure in west Philadelphia, in a subway through the central business district (CBD), and on an elevated structure again to the Bridge Street terminal in northeast Philadelphia.

There are 28 stations on the line. Twenty-three have side platforms, three have center platforms, and the two terminal stations combine the two configurations, i.e., they have both side and center platforms.

The trains currently operate with two-person crews: a driver and a conductor. The driver is positioned in a cabin at the head of the train on the right or outer side of the vehicle. The conductor, who is responsible for the operation of the doors, is positioned in another cabin along the train and changes cabins between stations with side and center platforms to see the respective doors.

The possibility was explored that trains on the Market-Frankford line be operated with only one crew member--the driver--on board each train. In order to operate with this system, the driver would have to assume all on-board duties. At the same time, a consistent level of service and equally safe operation as with two-person crews must be ensured.

To enable the driver to operate the train doors, the restrictions of location must be resolved. Unlike the conductor, the driver is located at a fixed place on the train--the front right corner of the first car--and cannot move from that point. The physical problems that must be solved so that the driver can perform door control from that location are

1. Adequate visibility for observation of boarding and alighting along both sides of the train and up to the maximum length of the train, and
2. Physical control of all doors from the cabin.

The driver can see all doors on the right-hand side by leaning out of the window. This is the case at 23 stations. At the three stations with center platforms, signals would have to be installed by which a person on the platform (or in the cashier's booth via closed-circuit television) would indicate to the driver when to close the doors. Currently, at the two terminals, a station attendant is already observing the doors.

Consequently, the change from two- to one-person trains on this line would require

1. Adding door control for the opposite (left) side doors in the driver's cabin,
2. Installing a signal system (and, possibly, closed-circuit television) at three stations,
3. Adding one platform attendant (if television is not installed) at each of the three stations with a center platform, and
4. Withdrawing half of the crew members from operations; this amounts to approximately 30 positions during peak hours.

Indications are that, although conditions (station design, operating methods) vary among cities, most older systems that currently operate with two-person crews could eliminate the second person with modest efforts.

CREW REDUCTION ON RGR SYSTEMS

Regional rail systems started their operations as special services of long-distance railroads. In most cities they are still operated in that manner. Railroad managements have considered RGR services as a separate duty that they, particularly in recent decades, do not want to have. Transit agencies, on the other hand, have little jurisdiction and little operating coordination with them. This situation made a drastic shift on January 1, 1983, with the withdrawal of the Consolidated Rail Corporation (Conrail) from many northeast commuter rail operations.

In spite of this increasing need for their services, RGR systems have recently been experiencing mounting financial problems. The main cause of these problems is that these systems in North American cities largely operate under obsolete, labor-intensive practices. Three major problems can be identified:

1. Overstaffing: Train crews consist of two to as many as seven (exceptionally even more) persons. In addition to the driver, there are usually a considerable number of other positions, many of which are given nebulous titles (fireman, brakeman, flagman).
2. Distribution of duties: Typically, each crew member has strictly defined duties and does not perform anything else. Often two or more persons do jobs that are performed at different times. Hence, these jobs could be handled by only one person.
3. Excessive wages: Crews on RGR systems receive higher wages than transit workers on similar and other much more difficult jobs (e.g., driving buses through congested urban streets) because they usually belong to national railroad unions. Moreover, allowances for split shifts and overtime are often high. Finally, there are a number of artificially imposed bonuses that have no rational basis.

The Media-West Chester line, 1 of 13 RGR lines that serve the Philadelphia metropolitan area, extends from center city Philadelphia in the westward direction to West Chester. It is 44.2 km (27.5 miles) long and has double track from Suburban Station in center city Philadelphia to Elwyn, and single track from Elwyn to West Chester. There are 27 stations on this line, with an average distance between them of 1.64 km (1.02 miles). All stations along the line have low platforms except two--Penn Center and 30th Street Station.

The line currently operates with a minimum crew size of three (which consists of one engineer and two trainmen) for one-car trains, up to a maximum crew size of seven (one engineer and six trainmen) for six-car peak-hour trains. Crew size varies depending on ticket-collecting requirements but, in general, an additional trainman is required for every additional two cars in the consist above the basic one-car, three-person operation.

The four major duties now performed by on-board train personnel are driving, opening and closing doors and moving traps, supervision of the boarding and alighting process, and fare collection. Any plan that proposes to reduce on-board crew requirements must provide alternative methods for performing the last three duties: operation of the doors and traps, supervision of boarding and alighting, and fare collection. Currently, at least one crew member is required to supervise boarding and alighting at each set of two adjacent doors for the following reasons, which are imposed by car and station designs:

1. Low-level platforms and high steps, which combine to make boarding difficult and slow;
2. The need to ensure that all passengers are within the passenger compartment before the train has started; and
3. The inability to fully close the vestibule, which leads to the possibility that a passenger may fall from the train.

The largest amount of time spent by the crews is related to fare-collection tasks. The current fare-collection method is similar to that of conventional railroad practice where the conductor must inspect and punch each ticket.

Five alternative methods of train operation for the conditions on this line will be compared in this section. These alternatives are

1. Current method;
2. Partial self-service fare collection with moderate crew reductions;
3. Full self-service fare collection with modifications to vehicle doors, which make operation with two-person crews possible;
4. Full self-service fare collection with construction of high-level platforms, which allows operation with two-person crews; and
5. Fully enclosed stations with automatic fare collection, which enables one-person crews.

Alternative 1: Current Method

The method of current operation (described above) was developed for operating conditions in the early 1900s, which have drastically changed since that time: labor wages have increased much faster than other cost components, numerous technological inventions have become available, requirements for higher speeds have increased, and so on.

The primary disadvantage of the current operating method is that it is the most labor intensive of all alternatives. The use of large crews combined with the high wages of railroad workers (they are one of the highest paid blue-collar groups) results in extremely high operating costs for this transit mode.

Alternative 2: Partial Crew Reduction

Alternative 2 uses elements of both the current and the self-service fare-collection methods to ease the task of ticket collection and inspection. This allows the reduction of train crews to the minimum required for safe supervision of boarding and alighting of passengers and a reduction in station agents.

The major capital expense is the purchase of ticket vending and cancellation machines for some stations. Because no major modification would be required in vehicles or stations, this alternative could be implemented in a relatively short time.

Because low-level boarding and alighting would be retained with this alternative, and because boarding and alighting requires the presence of a crew member for safety, the crew reduction would necessitate that a smaller number of doors be opened. Each crew member would supervise two doors on close ends of two adjacent cars. It should be noted that passengers in cars in the center of the trains with four or more cars would not be able to enter or exit through doors at one end of the car.

Because both 30th Street and Penn Center have high-level platforms, all exits could safely be used for unloading without crew members supervising them. However, this would require remote door control. Because this alternative requires no modifications in vehicles or stations, it can be used as an intermediate step before full implementation of self-service fare collection. Compared to the current method of fare collection, alternative 2 offers the following advantages and disadvantages:

1. Advantages: (a) reduction in crew requirements by one to two crew members per train; (b) reduction in station ticket agent requirements because tickets could be purchased from vending machines or many off-line locations; and (c) provision of a system of checking the proper zone and destination for the ticket; and
2. Disadvantages: (a) requires capital and maintenance cost for installation of ticket vending and cancellation machines, and (b) passengers will not be able to board and alight at all train doors because of reduced crew size.

Alternative 3: Vehicle Modifications

Alternative 3 requires modification of doors so that they can close regardless of the position of traps. This involves long doors that would extend down to the level of the lowest fixed step rather than only to the car floor, as is currently the case. This modification would permit two operational improvements. First, vestibules in cars would always be enclosed during train travel, which eliminates the possibility of passengers falling from a moving train. Second, combined with a few other changes, this modification would enable the boarding and alighting process to be carried out without direct supervision by a crew member.

In conjunction with a self-service fare-collection system, this method of train operation could reduce crew requirements for all trains to two: the driver and the conductor. The driver, in addition to the traditional duty of driving the train, would open and close doors and announce upcoming stations. Operational difficulties would be encountered for specific locations but, through an examination of alternatives, it is believed that these obstacles would not be insurmountable. Compared to the current operation, this alternative method has the following advantages and disadvantages:

1. Advantages: (a) reduction in train crew sizes, ranging from one to five persons; (b) reduction of the number of station agents (due to introduction of machines and sales through other outfits); (c) increased safety due to closed doors during train travel; (d) reduced underpayment of fares (currently undetectable in many cases); and (e) better station announcements via a public address system; and
2. Disadvantages: (a) requires a major investment in door retrofitting, (b) requires investment in ticket vending machines, and (c) reduces assistance to passengers during boarding and alighting.

Alternative 4: High-Level Platforms

Alternative 4 is similar to alternative 3 with the exception that safe boarding and alighting would be accomplished through construction of high-level platforms rather than through door modifications. The current door and step arrangement would not need to be modified, as the trap would remain in the lowered position, which fully encloses the vestibule area. Again, door control is accomplished by the driver while the conductor would assist in door supervision and departure control. The self-service fare-collection system remains unchanged from the previous alternative.

Two options are available for the construction of high-level platforms along the Media line:

1. Raising the platform level at every station from Philadelphia to West Chester, or
2. Raising the platform levels only at stations on the heavily used portion of the line from Philadelphia to Elwyn; the light passenger loads between Elwyn and West Chester can be handled by two-car trains, which are small enough for the trap and door supervision to be handled by one conductor.

Although this alternative accomplishes the same objectives as alternative 3, construction of high-level platforms has important impacts on other aspects of the operation, including passenger comfort, operating speeds, and freight service.

In comparison with the current method of operation, construction of high-level platforms along with self-service fare collection offers the following advantages and disadvantages:

1. Advantages: (a) reduction in train crew sizes, ranging from one to five persons; (b) reduction in the number of station agents; (c) safer and more comfortable boarding and alighting; (d) faster boarding and alighting, which results in higher operating speeds and reduced vehicle requirements; and (e) reduced underpayment of fares; and
2. Disadvantages: (a) requires a major investment in high-level platforms, (b) requires investment in ticket vending machines, and (c) restrictions on freight car size.

Alternative 5: Fully Automatic System

Alternative 5 incorporates a fully automated fare-collection system. Passengers would purchase tickets from automatic vending machines and enter and exit the station area through automatic turnstiles. No on-board train personnel are required for fare-collection tasks and train crews could be reduced to one. This system would require rebuilding of all stations to provide a separate, enclosed paid area.

Comparison of Alternatives

The final alternative should be selected on the basis of the most favorable economic and operating results and service characteristics that affect passengers. To make a clear comparison of these on the basis of the preceding analyses, the major items that differ among the alternatives are summarized in Table 2.

Conclusions and Recommendations for RGR Operations

Each of the alternatives provides a method of bringing about reductions in on-board crew requirements. Because Philadelphia has an RGR system that includes low-level platforms and doors that do not fully enclose vestibules for low-level boarding, it presents a worst case for bringing about these changes. RGR systems in Chicago, New York, parts of the New Jersey Northeast Corridor Line, and San Francisco incorporate at least one of these features and would be easier to convert than the Philadelphia system.

It is also important to consider the impact of the Center City Commuter Connection on the alternatives. This project, to be completed in 1984, will connect the former Penn Central lines (including the Media line) with the Reading lines. Therefore, a change in fare-collection and passenger loading procedures on the Media line will require a corresponding change on the Reading line with which it will be connected. The lines on the two systems are similar, and it is possible to accomplish this without major difficulties. Successful implementation of one of these alternatives can lead to its introduction on the remaining RGR lines.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The current conditions on many rail transit systems in North America are, in some ways, illogical. The rail mode, which potentially has by far the highest labor productivity and therefore the lowest unit operating costs, does not fully use that potential. Although the operations of several rail transit systems (Lindenwold Line, BART, MARTA) clearly indicate that a high level of automation is possible, there are still systems of all modes (LRT, RRT, and RGR) that have the same intensive labor use as they had in 1900-1920 when the cost of labor was much lower and technology much more primitive.

Table 2. Comparative analysis of alternatives 1-5.

Alternative	Comparison Items: Crew Size	Vending Machines	Cancellation Machines	Vehicle Modification	High-Level Platforms	Station Rebuilding	Reduced Assistance to Passengers for Boarding and Alighting: Advantage	Disadvantage	Cost ($000 000s)
1	3-7	None	None	None	None	None	-[a]	-[a]	0
2	2-5	Low-medium	Low-medium	None	None	None	Fewer station agents Positive control of zone fares	Fewer doors open Requires maintenance of vending and cancellation machines	2-4
3	2	High	High	High	None	None	Fewer station agents Travel with closed doors (higher safety) Reduced fare evasion	Reduced assistance to passengers for boarding and alighting Requires maintenance of vending and cancellation machines	4-6
4	2	High	High	None	High	None	Fewer station agents Reduced fare evasion Faster and safer boarding and alighting Reduced vehicle requirement	Restrictions on freight service Requires maintenance of vending and cancellation machines	8-12
5	1	High	High	None	High	High	Fewer station agents Reduced fare evasion Faster and safer boarding and alighting Higher operating speed Reduced vehicle requirement	Restrictions on freight service Requires maintenance of vending and cancellation machines	12-15

[a]The current base system.

The study shows that train crew reductions can decrease operating labor costs significantly, in most cases to nearly 50 percent on some LRT and RRT systems and to 30 percent of the current costs on some RGR systems. Most streetcar and LRT systems cannot decrease their crews, because they already have one-person operation. But those with MU operation can reduce crew size by the introduction of self-service fare collection (following the examples of Edmonton, Calgary, and San Diego). Older RRT systems can reduce their crews to one person with minor changes and limited investment.

RGR systems can realize by far the greatest potential in savings through crew reductions. They must, however, undertake somewhat more extensive changes, such as redesign of car doors, construction of high-level platforms, or introduction of self-service fare collection. Improvements in productivity require certain planning and capital investments, but these would be easily compensated by the large savings in operating costs from crew size reductions. Because of special operating features of the RGR mode, it is not expected that these crews can be reduced below two members.

Technical problems of the proposed changes are in most cases minor. Some measures required on a few RGR systems are an exception. The major obstacle in many cases is the opposition of labor unions. The cost of this opposition is, however, so high that the existence of these modes is being threatened. Time for major changes and modernization has come; they cannot be delayed much more.

It is recommended that all transit operating agencies that potentially can benefit from crew reductions immediately initiate activities along two lines: (a) planning of the physical and operational changes needed for crew reduction, and (b) negotiations with the labor union or unions and search for cooperation in the needed modernization.

There are several measures that can make crew reductions more acceptable to labor unions. They are

1. Stipulation that most of the benefits from crew reduction are passed on to the public through higher frequency of service (so that the same number of employees is retained); this is applicable to off-peak RRT operations;
2. Reassignment of the freed crew members to other duties; and
3. Increased wages (e.g., 10-15 percent) for the reduced crew members; thus, the savings would be shared by the agency and its employees.

In conclusion, the study has clearly shown that, on rail transit systems that currently have larger crews than modern operating practices require, improvements of productivity are usually possible. Relatively small efforts to reduce crews can often bring considerable and permanent saving without service degradation. The alternative to such actions may, in some cases (RGR), be catastrophic, e.g., discontinuance of services. It is therefore recommended that UMTA strongly support transit and railroad agencies interested in this problem by disseminating information on possible methods for train crew reduction and by assisting with labor negotiations. Such action would be in the public interest.

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