Preparation for "Show Time"

The Los Angeles Story

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The Los Angeles-Long Beach Light Rail Transit Project is scheduled to begin revenue operations in 1990. With the $700-million, 21-mi project already under construction, careful planning and coordination are being conducted to ensure that the system will give a stellar performance on the day of its debut. A test track will be constructed so that vehicle acceptance can proceed uninterrupted while construction of the system continues. Staffing is an area where early planning has already begun to pay off by providing an accurate picture of first-year operational expenses and by establishing an incremental plan to bring on staff just in time to meet the needs of each development phase. Planning for the training of operating and maintenance employees is also under way. And a detailed testing plan has been put together to verify the system equipment at every stage of development. Other considerations include labor agreements, logistics of spare parts and supplies, public relations and marketing, contingency plans, maintenance vehicles and shop facilities, and safety certification.

THE LOS ANGELES-LONG BEACH Light Rail Transit (LRT) Project is the forerunner of a projected multiline light rail network that will, it is hoped, someday encompass the entire Los Angeles basin. The initial line (see Figure 1), running some 21 mi from downtown Los Angeles to Long Beach and making 22 stops, is scheduled to open in July 1990.

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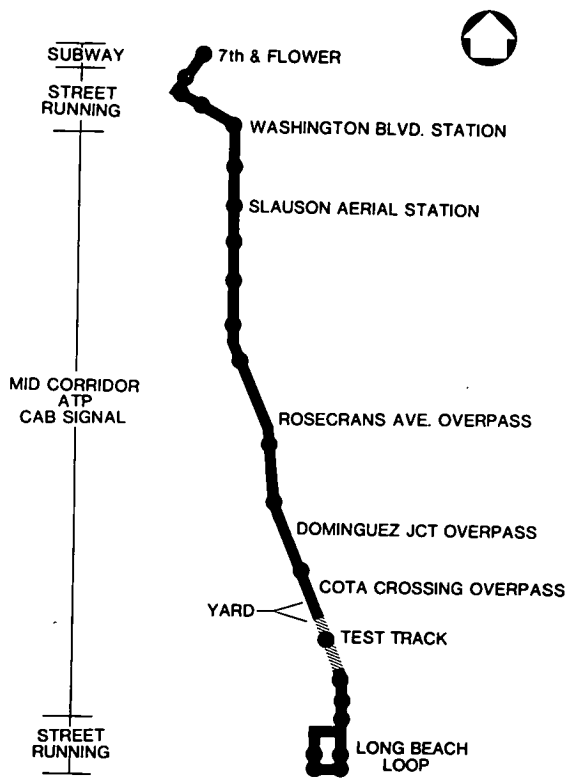

FIGURE 1 Los Angeles-Long Beach LRT schematic.

The Long Beach line will use conventional, state-of-the-art light rail technology: driver-operated articulated rail cars moving largely over surface tracks, interfacing with automobile traffic at numerous grade crossings, and including approximately 6 mi of street traffic operation. There will also be about 1 mi of subway operation in downtown Los Angeles, plus several short stretches of elevated structure serving as flyovers across congested areas.

Stations will be high-platform. Train-operator controlled track switches and a cab-signal system will govern train movements on areas of private right-of-way. A supervisory control and data acquisition system (SCADA) will allow central control dispatchers to monitor and control the traction power supply system, monitor train movement and ticket vending machines, and operate some interlockings during emergencies. Street-running and yard movements will be governed by an operations rule book.

The fare collection system will be the self-service system that has been successfully demonstrated in at least seven North American cities to date.

Two-car trains will predominate in the operation, running on 6- to 10-min headways in peak periods, 15- to 20-min headways off-peak. Initially, the light rail vehicle (LRV) fleet will number 54 and will be constructed by the Nippon-Sharyo works in Japan.

The cars will be delivered in "halves" and assembled in the newly constructed maintenance shop in Long Beach.

Funding for this $700-million project is entirely local, much of it coming from a 0.5 percent sales tax locally referred to as "Prop A" funds after the proposal was enacted in early 1981. Design of the system began in earnest in early 1985 and ground-breaking occurred October 31, 1985, at the Long Beach shop site. Much of the route alignment is shared with the Southern Pacific Railroad, which must maintain its freight service during the 4½-year construction period—not an easy task.

Although 4½ years may sound like a lot of time to spend building track on an existing right-of-way, when one takes a closer look at all of the individual pieces of the giant puzzle that must mesh together, time is of the essence if the trains are to roll on the scheduled opening day.

Few projects of this magnitude (aside from space exploration) involve more disciplines plus the public than a rail transit project. The Los Angeles project ranks among the biggest and is without question the largest single light rail project in this country. The list of players, all of whom have a role in opening the system, is awesome. Architects, planners, schedulers, engineers, draftsmen, politicians from many diverse constituencies, administrators, clerical workers, technicians, public relations persons, equal employment opportunity (EEO) officers, contractors, procurement specialists, insurance specialists, legal counsel, journeymen, utility companies, real estate agents, developers, parking authorities, traffic engineers, the state Public Utilities Commission, safety experts, police and fire jurisdictions, newspaper reporters, tax authorities, vending machine salesmen, the local bus operating agencies, test coordinators, operator training specialists, and on and on—all play active roles. Getting all of these people and organizations to work together towards the same goal is tantamount to getting a large army of fleas to march in step.

Yet by June 1990 the taxpayers of Los Angeles will have been paying sales taxes for 9 years and for 9 years they will have been reading about the promised beginning of the end of their gridlock nightmares. For over 4 years they will have been negotiating construction disruption in downtown LA and elsewhere. For as long as they can remember, they have been fed promises of this great new set of trains that will whisk them to their jobs conveniently. If the day arrives and the trains are not there, the taxpayers will vent their wrath in the press and at the polls. Our duty is not to let the public down when the big day arrives. That big day is what we are referring to as "Show Time."

To make all this happen, the planning must begin early in the design stage of the project. Actually it begins with the schedulers who determine which segment of the line has a possibility of being operable at the earliest date. Presently the Los Angeles County Transportation Commission (LACTC) is planning to start the system in two stages. The first stage, opening in July 1990, includes the entire system except the subway section, which is scheduled to open in December 1990.

Our story of getting ready for "Show Time" begins then in early 1985 when the final Environmental Impact Statement was approved, the route alignment was finally chosen, funding was in place, and a design engineering consulting team was brought on board to do the planning and design work.

TEST TRACK

From the very early days of the project, the need for a test track was recognized so that vehicle acceptance could proceed uninterrupted while construction of the system continued. The area selected for the test track is between the yard departure track and the Willow Station pocket track, a distance of approximately 10,300 ft. There are two grade crossings on the test track, but there is sufficient distance between the crossings for high-speed (55-mph) performance testing of the LRVs.

To ensure that at least the minimum requirements for a test track will be completed in time to support vehicle acceptance, schedule milestones were included in all the system contracts and some construction contracts. A special effort will be made by all our resident engineers to make sure that the test track work proceeds expeditiously so that vehicle acceptance will not be delayed. This includes the portions of the yard and shops required to support the vehicle deliveries.

STAFFING

Another area where LACTC and its consultant staff initiated early planning was staffing. Besides giving us a very accurate picture of what operating expenses will be for the first revenue service year, this early planning will also allow smooth transitions from the testing phase through the prerevenue and revenue service phases of the project. The staffing plan for the system is incremental throughout the test and start-up phase, with personnel being brought on board only as needed to support testing, to ensure sufficient training time, and to provide preventive maintenance on equipment already accepted.

TRAINING OF PERSONNEL

A well-rounded training program is of key importance to the timely opening of the system and to ensure the safety of our passengers during the initial stages of revenue service. For the purposes of these discussions, our employees can be divided into two categories, operating employees and maintenance employees. We will not discuss the training of supervisory or specialized personnel, such as dispatchers, because these people will be hired as experienced personnel, and will only be required to familiarize themselves with the new environment and equipment.

Training of operating employees (see Figure 2) will consist primarily of two separate classroom sessions, with a lot of hands-on training in operating the vehicles before and after each session. The testing period will be an essentially hands-on training opportunity for the operators.

The operators will be given two written tests during their training period. The first will cover safety rules and those portions of the rules that pertain to test operations only. The second will involve the entire operating rules and procedures manual. This is done to avoid confusion, because operators must perform test operations with some rules and procedures that will not apply until prerevenue tests begin. The prerevenue test period is considered the final for operating personnel. During this period the operators' adherence rules and procedures, their reactions, and their responses to emergency and abnormal conditions will be evaluated and graded. Those requiring additional training, or those unsuitable for continued service, will be identified.

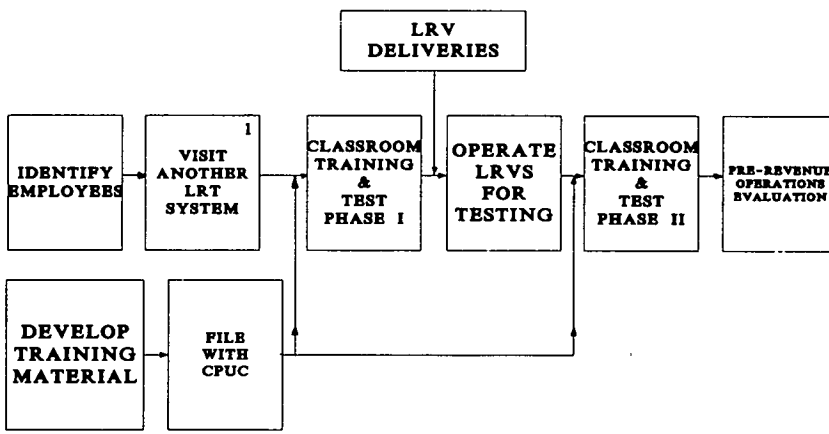

FIGURE 2 Training phases for operating employees.

The maintenance personnel (see Figure 3) hired for skilled positions will be required to possess at least basic skills. If the decision is reached to make the hiring of existing personnel a priority, some basic skills training may be required, particularly in electronics. This basic skills training will have to be coordinated with various technical schools in the area. All of the system's equipment specifications include requirements for vendors to provide classroom and hands-on maintenance training for our employees.

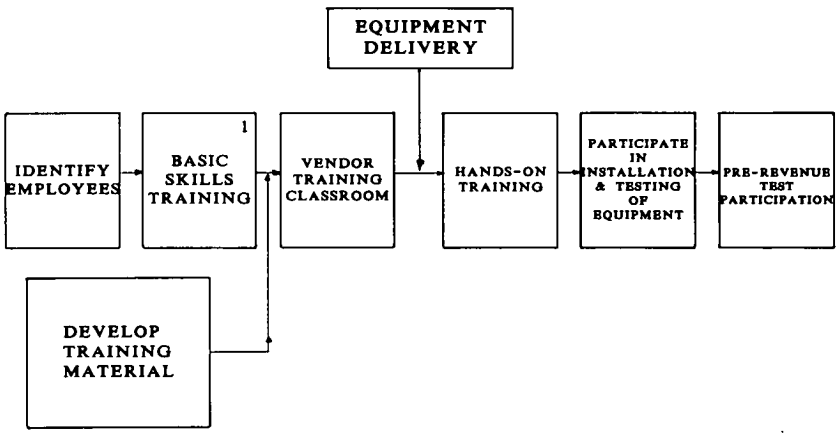

FIGURE 3 Training phases for maintenance employees.

Maintenance personnel will also be used to monitor tests and will participate under the direction of the contractor in any retrofit or repair work on the equipment. This will provide our maintenance personnel the opportunity to gain further experience with the equipment.

TESTING OF THE SYSTEM

Test planning also started very early in the program and a very complete test program has been devised to accomplish four goals:

1. Demonstrate the safety and service characteristics of the system;
2. Validate and demonstrate system performance;
3. Verify contract compliance; and
4. Train personnel and integrate personnel, equipment, and procedures.

Test sections of the various contracts have been very carefully written to require the contractor to verify the equipment at every stage of development,

starting with materials and manufacturing tests, the installation verification tests, and finally the integrated tests to verify that all systems work together as a fine-tuned light rail system.

Figure 4 is a flow chart of the field testing that will be taking place in a typical section of the midcorridor. Only tests that will be performed in Los Angeles are shown, but factory or qualification tests to be done at the factory are excluded. Numbers in parentheses in the following discussion correspond to the numbered tests in Figure 4. Starting from the left, the vehicle acceptance test (1) is performed at the test track on every vehicle received. After each LRV successfully completes this test, it will be used on integrated tests on other sections of the system. The vehicle test involves the verification of performance requirements in the specifications (such things as acceleration and deceleration rates, brake cylinder pressures, motor currents, etc.). The automatic train protection (ATP) and train-to-wayside control (TWC) vehicle equipment will also be tested to verify proper operation with the wayside installation.

After accepted vehicles are available, clearance tests (2) of the particular section under test will be performed. This test involves fitting a vehicle with a simulated dynamic profile to verify that proper clearances exist at all the physical facilities on the right-of-way, such as poles, switch machines, platforms, etc.

Overhead catenary system (OCS) mechanical and electrical tests (3) are the next step in the testing process. After mechanical checks have been done to each section of the OCS to verify the height and stagger of the contact wire, and after electrical installation verification tests (such as circuit continuity and loop resistance), hi pot insulation tests, and grounding resistance tests are complete, dead wire run tests (4) will be performed on the particular section. This test consists of using an LRV pulled by a rail-mounted vehicle to verify the pantograph sway and pantograph clearance envelope. This test is performed at several speeds in 5 mph speed increments.

Traction power supply system installation tests (5) are conducted at each traction power substation. These include insulation resistance tests, circuit continuity tests, and grounding system tests. The section will then be ready for the energization test (6) to verify proper voltage in the OCS.

Live wire tests (7) will then be performed to evaluate the collection performance between the LRV and the OCS. These tests will be done at various speeds (starting at 5 mph) in increments of 5 mph. Videotape recordings will be made of the interface between the pantograph and the OCS to verify behavior on various contact wire profiles and to show loss of contact, smooth transitions at overlaps, cross contacts, turn outs, and section insulators.

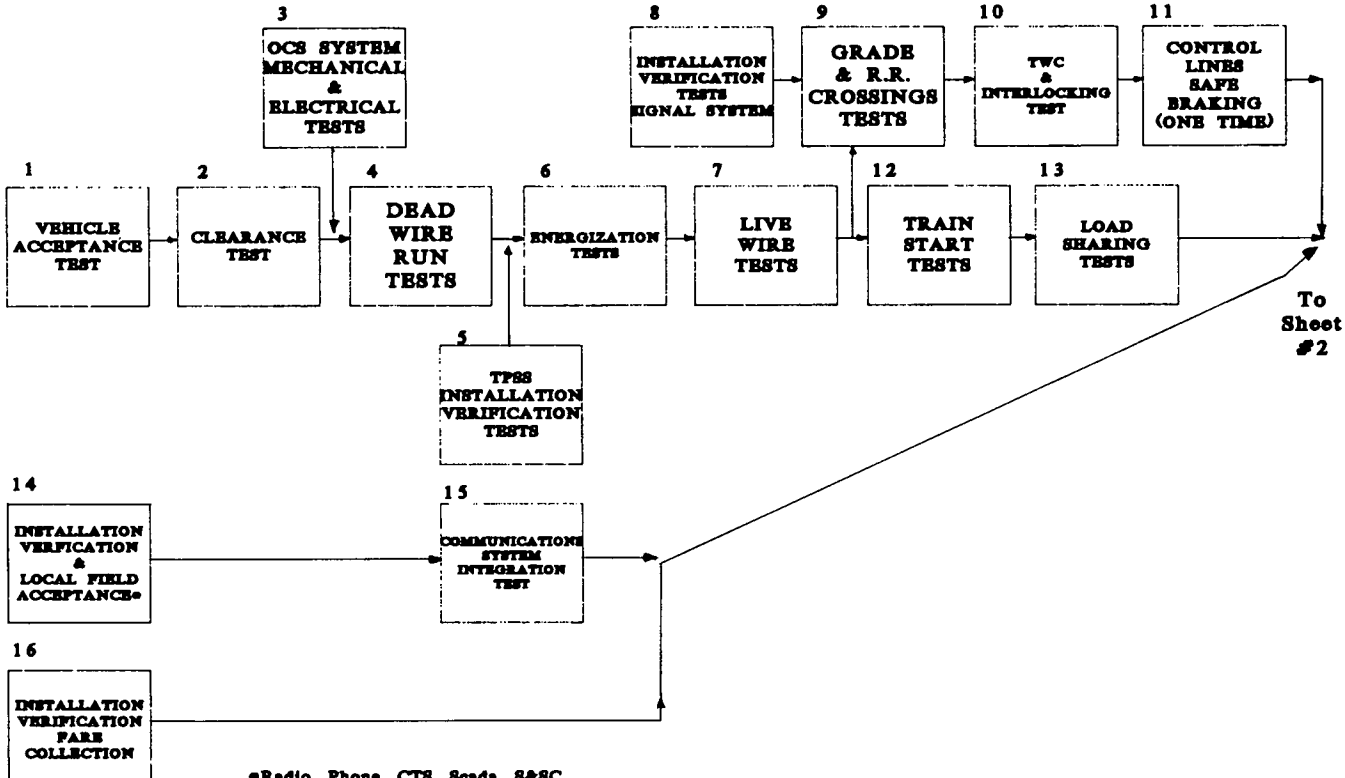

FIGURE 4 Testing phases for LRT components.

The signal system will be tested (8) after the proper installation verification tests of the signaling equipment are complete. These include tests of cable continuity and resistance, power bond resistance, insulated joints, switch machine installation, energy distribution, AFO and ac track circuit adjustment, signal adjustment, line circuits, traffic circuits, TWC, and interlocking verification.

Every grade crossing and railroad crossing will be thoroughly tested (9), first using shunts and then using actual LRVs. Grade crossing protection operation and timing will be verified for all speeds. Railroad crossings will be tested from both the LRT side and the Southern Pacific Railroad side. The TWC operation will be verified at all locations using actual LRVs and verifying every request at each location.

TWC and interlocking tests (10) follow. Each interlocking will be thoroughly tested to verify that the vital circuits, switch locking, detector locking, and signal locking operate as designed. All routes will be checked and route security proven using actual LRVs.

Next come the automatic train protection system tests and the safe braking test (11). Control lines will be tested with actual LRVs to verify that the correct speed command is received in each track circuit for every condition of track occupancy in the block preceding the track circuit under test. The test will be performed with one LRV incrementing from track circuit to track circuit. For one selected track circuit a safe braking distance test will be performed to verify that block design is sufficient to ensure safe train separation. An LRV with derated braking characteristics will be used for this test. These tests, of course, will not be performed in the downtown sections—Los Angeles and Long Beach—but traffic signal sighting tests will be performed there.

At each traction power substation one two-car train-start test (12) will be performed to verify the proper operation and coordination of the dc feeder breakers during the start. Also at each substation the proper load sharing of the two ac-to-dc conversion assemblies will be verified (13) during a three-car train start.

Local field acceptance tests (14) will be conducted on all the communications systems, namely the cable transmission system, SCADA, radio, telephone, public address, closed-circuit television, fire detection and suppression monitoring, and intrusion detection systems. When these are completed, an integrated test of the communications systems (15) will be conducted.

Installation verification tests will be conducted at each ticket vending machine (16). These will verify their proper operation and data reporting to the central data computer as well as the maintenance record-keeping computer.

After every section of the system has been tested as indicated in the preceding paragraphs, complete system tests will be run (see Figure 5).

The capability of the signal system to perform as designed will be verified by performing a system operations test (17). Three-minute headways and a three-hour-long rush hour simulation test (18) will be performed. Some failure modes for the signal system will be verified during this test.

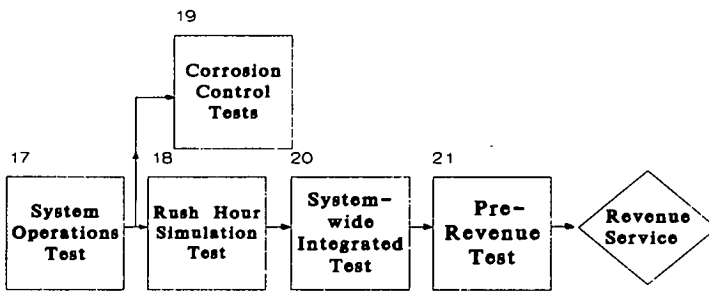

FIGURE 5 Testing phases for systemwide integrated tests.

Corrosion control tests (19) will be performed in conjunction with the simulated rush hour test to verify the effectiveness of the corrosion control measures installed within the transit system.

After all the above testing has been completed, a systemwide integrated test (20) will be performed by the LACTC and its consultant staff. This test will be attended by representatives of all the system contractors. Its purpose is to verify the complete integration of the SCADA, LRVs, signaling, traction electrification system, fare collection, and the various communications systems. The function of every annunciation and control circuit will be verified and all the operating features of the LRT system will be demonstrated.

After the systemwide integrated tests have been completed, the prerevenue operations phase will start. All testing up to this point is intended to verify equipment operation. The prerevenue operations tests (21) are intended instead to verify the knowledge and reactions of people.

There are three kinds of prerevenue operations tests, namely, those for normal revenue operations, abnormal operations, and emergency scenarios. All of the system equipment elements and operating employees will participate in these tests. The performance of employees will be observed and graded. Operating employees include the train operators, their supervisors, dispatchers, the maintainers, and their supervisors. The appropriate emergency response units for all of the areas over which the system operates will be called upon to participate in the emergency scenario portions. Employees who do not perform adequately will be scheduled for retraining or

termination. Then, and only then, if all safety certification requirements have been satisfied, the system will be ready for revenue service.

OTHER CONSIDERATIONS

Several other considerations must also be dealt with: labor agreements, logistics, public relations and marketing, contingency plans, maintenance vehicles and shop facilities, and safety certification.

Labor Agreements

In the very near future some important policy decisions have to be made regarding the source of employees for the light rail system. If it is decided that the employees must come from within the ranks, negotiations must begin in the not too distant future. An agreement must be developed under which the operating employees can make the transition from the bus system to the rail system. Such issues as separate rosters for rail employees must be addressed by union and management alike. The trend towards privatization will also be considered. The cost and benefits of having any of the work performed by available private contractors must be known prior to any negotiations.

Logistics of Spare Parts and Supplies

All the systems contracts contain provisions for the equipment contractor to provide spare parts and special test equipment. They also must provide a suggested list of consumable and special tools. Decisions on the types and quantity of consumable supplies and tools need to be made in the near future. Work on the layout of the storeroom, presently under construction, also needs to be initiated.

Public Relations and Marketing

Some brochures have been prepared in English and Spanish to inform potential patrons and others about the LRT. An additional concentrated effort must be made through the media prior to revenue operations to ensure proper exposure to all our potential riders. Decisions must be made about whether demonstration rides will be given during the testing period (i.e., at the test track) or if a period of free rides will be instituted prior to revenue service.

Contingency Plans

During the entire process, contingency plans are constantly being formulated to cope with construction delays in certain line sections and facilities. Some contingency plans have also been made for opening smaller segments of the system, should it become necessary.

Maintenance Vehicles and Shop Facilities

Various high-rail maintenance vehicles must be purchased, tested, and their operators trained. Because these vehicles will not shunt the signal system and be detected, appropriate rules must be developed and incorporated in a rule book. Employees operating this equipment must be trained and tested.

Safety Certification

LACTC will be self-certifying the safety of the LRT. For this purpose a self-monitoring safety auditing program is being developed by our consultant staff to verify that all practical steps have been taken at every stage of the design and construction to maximize operational safety. Not until all the required steps identified in the testing section are fulfilled will revenue service start.

IT'S SHOWTIME

It's July 4, 1990. The largest metropolis in the world without a mass transit system is about to lose that dubious distinction. Standing in back of the big ribbon is simply "a train" that represents the fruits of at least 70 years of planning, proposals, propositions, referenda, lobbying, debate, schemes, dreams, and a lot of hard work on the part of the people who pulled together to make it all happen.

If the Long Beach line is typical of light rail lines in general, it will carry about 1,000 percent of typical daily patronage that first day, partly because the price is right on that day only (free), but mostly because curiosity is riding at an all-time high.

The success or failure of this "show time" is a direct result of how carefully thought out the practice sessions were. How many rehearsals were done? To what degree was the testing carried out? Were the test data properly analyzed? Were deviations from the norm detected? Were corrective actions identified? Was retesting carried out to determine if the corrective action

fixed the problem? If the trains prove unreliable, the reason will undoubtedly be traceable to one or more of the equipment suppliers. However, it will be LACTC, RTD, and the designer that will suffer the black eye. The final report card will be handed out by the media. If the image is favorable and the patrons perceive the rail system as reliable, then they will ride it and ridership statistics will be favorable as well.