CASE STUDY OF THE JFK AIRPORT AIRTRAIN

Prepared for

World Conference on Transportation Research
Special Session on Urban Transportation Megaprojects
Lisbon, Portugal

July 13, 2010

By

Charles Brecher, New York University
Patrizia Nobbe, City University of New York

INTRODUCTION

This case study on the light rail system at John F. Kennedy International Airport in New York, short: AirTrain JFK, is one of a series prepared for the Omega Centre's study of urban transportation "megaprojects." These are defined as projects costing more than one billion dollars, and the case studies involve projects completed in the early part of the 2000-2010 decade.

The case study addresses three questions:

1. How well did the project meet its initial objectives, and how, if at all, did those objectives change over time?
2. How well did the project address and respond to current normative concerns with sustainable development?
3. How well did the project decision making address the challenges of uncertainty and complexity confronting sponsors of megaprojects?

The remainder of this paper is organized into three sections that deal with these three questions and a final section that presents the authors' suggestions for lessons learned for future mega-project decision making.

PROJECT OBJECTIVES

The conventional criteria for assessing projects include whether they were completed in accord with the approved design, whether they were completed within the authorized budget, and whether they were completed in accord with the initially approved schedule. Additional relevant objectives include achieving projected volumes of traffic and revenue.

Initial Objectives

Design. The official sponsor of AirTrain JFK is the Port Authority of New York and New Jersey (PA). The project approved in 1996 by the PA Board, and one year later by the funding and regulatory agencies, the New York State Department of Transportation and the U.S. Department of Transportation, consisted of a light rail system (LRS) using automated guideway transit (AGT) technology running on dual track for 8.1 miles (13.03 km) and having 10 stations. The 10 stations included terminus points at the Jamaica station of the Long Island Railroad and subway station and at the Howard Beach subway station and interim stations at Lefferts Boulevard, the long-term parking lot, and a rental car and shuttle service station; the other stations are airline terminals within the JFK airport complex. A circular service within the airport was to be free; service to Howard Beach and the Jamaica terminal required fares projected at $5 for air passengers and $2 for employees in 1997. The Port Authority did not specify plans for future price increases.

Schedule. The schedule for the project called for revenue service to begin on the airport circulator route and the Howard Beach route approximately 48 months after the contractor was given notice to proceed and Jamaica service to begin 12 months later. The contract was awarded in May 1998, and it called for start of the initial service on the Howard Beach branch in the fourth quarter of 2002 and full service by mid-2003.

Budget. The PA's initial approved budget for the project was $1.6 billion. This included about $400 million of direct PA expenses and nearly $1.2 billion for a contract with a consortium. The PA was responsible for land acquisition, certain mitigation expenses and 10-20 percent of the design work. The private consortium was responsible for the remainder of the design work, construction costs, and operation and maintenance of the system for the first five years. The contract budget consisted of $930 million for design and build work, $105 million for the five years of operation and maintenance, and $129 million for a contingency fund. The contingency fund was available for unanticipated expenses, and any unused portion of the fund would be split 40 percent to the contractor and 60 percent to the PA. The private consortium was responsible for any cost over-runs exceeding the contract amounts.

In early 2001 the PA increased its budget for the project to $1.9 billion. This increase reflected an agreement between the PA and the Metropolitan Transportation Authority (MTA), which operates the Long Island Railroad (LIRR), that the PA would provide the MTA with funds to help finance improvements at the LIRR's Jamaica station. While the scope of the initial project included an Airtrain station adjacent to the LIRR station, the new agreement included a project to enhance the AirTrain station and the link between the two stations and enhance the LIRR station to facilitate 'seamless' intermodal transfers and create a 'Gateway' to JFK. The AirTrain Terminal included an LIRR eight story office tower (funded by LIRR) above the terminal with capacity for future 'Air Rights' development of a ten story office tower or hotel above. The Jamaica Intermodal Terminal at LIRR was designed by PA and construction procured under a separate contract. The contract for the new work was awarded by the Port Authority to the joint venture of Perini/Tudor Saliba and was funded with $326 million from the PA and additional $172 million from MTA.

Passenger volume. In its first year of operation the AirTrain was projected to attract an average of 33,880 passengers daily. Of this total 22,950 were projected to be passengers using the free intra-airport service, and 10,985 were to be fare paying passengers to Howard Beach (about 4,000) or Jamaica (about 7,000). At a $5 fare, this implied average annual revenue of about $20 million. This almost covers the average annual operation and maintenance cost under the contract (about $21 million), indicating the PA did not plan substantial continuing operating subsidies for the AirTrain.

Actual outcomes

Design. The project was completed in virtually full accord with the design intended in the initial project approvals. The route, stations, equipment and service conform to the approved project descriptions.

While the previous statement is accurate, it should be interpreted in the context of two important contextual themes. First, the eventually approved design was a compromise from previous proposals and was (and continues to be) subject to criticism. Second, during construction the scope of the project was modified in ways that required action and funding by agencies other than the PA, and this is not reflected in the outcome as experienced by the PA as the official project sponsor. However, the actions by other agencies generally were prudent efforts to change the timing of their plans for improvements likely to otherwise happen somewhat later.

Approval of the AirTrain project in 1997 was preceded by more than 20 years of planning efforts. One widely publicized proposal initially advocated by the PA was a 22-mile AGT-system connecting JFK and LaGuardia airports to a terminal at 59th Street on the East Side of Manhattan. The AirTrain was a radical modification of this proposal, replacing the 22-miles proposal by the current LRS specification, and eliminating the connections beyond Jamaica to LaGuardia and Manhattan. This dramatic contraction in the design was deemed necessary due to the high cost of the initial proposal and opposition from community groups living near the proposed Manhattan terminal.

A major influence on the new design was the mechanism chosen to finance the project. In 1990 federal legislation authorized the Federal Aviation Administration (FAA) to permit local public bodies operating airports to impose a $3 per departing passenger Passenger Facility Charge (PFC) on the airlines. The money could be used for improvements to airport facilities. In 1996 the PA received authorization to use a PFC at Newark International Airport to build a LRS connecting the Newark air terminals and an Amtrak and New Jersey Transit station to be constructed adjacent to the airport. In 1997 the PA proposed using the PFC to fund major portions of a similar system for JFK airport. Running the system to Manhattan may have violated or dramatically stretched the restrictions on the use of PFC funds, which were intended for on-airport improvements. The eventual design still required use of PFC money to run the route more than three miles off the airport to Jamaica and to use a right of way (the Van Wyck Expressway) that the airport did not control. Initially the airlines objected to this use of PFC funds, fearing a precedent allowing PFC revenue to aid mass transit, but eventually political pressure on the airlines from the PA and other sources abated the objections and the FAA approved the project. (It should also be noted that two lawsuits were filed by the airlines and others to challenge the FAA's approval of PFC funding for the project. The FAA won both.) However, the nature of the funds being used did reinforce a need to restrict the scale of the project and limit its integration with mass transit facilities.

The revised design was and continues to be criticized because it does not provide a "one seat" ride from the JFK terminal to Manhattan. Passengers must either change to the subway at Howard Beach or the LIRR or subway at Jamaica. Both transfers involve carrying luggage by hand from one mode to another. Scheduled travel time from JFK to Manhattan via the subway at Howard Beach is between 63 (peak) and 70 (off peak) minutes; travel time via the LIRR at Jamaica is 34 - 42 minutes. The time needed for passengers to buy a ticket(s) and unscheduled delays often make actual travel times significantly longer. (It should also be noted that this compares favorably with the time for vehicular travel to and from JFK and Manhattan on the Van Wyck and Long Island Expressways which can approach and exceed 2 hours during peak periods.)

In response to these "one seat ride" criticisms, the AirTrain route, including grades, curves and track gauge, was designed so that it might eventually accommodate vehicles that could ride on subway and/or LIRR tracks. The integration with these public transit operations would take place after completion of the initial project and without PFC funding. This transformation would require new design elements for the vehicles, since the AirTrain cars have no motorman or conductor, while LIRR and subway equipment operate with both. The concept was to design a vehicle that could transfer from being operated by an engineer on the MTA routes to a computerized operation on the current Airtrain route. In years since the opening of AirTrain service, the PA has financially supported two studies by the MTA exploring the feasibility of "one-seat" rides to Penn Station and to Lower Manhattan. The Penn Station study indicated the original design remained feasible. However, no subsequent action to implement this new service has been initiated.

Another feature included at the time the project was proposed was the capacity to check airline baggage at the Jamaica station. The design was intended to provide the AirTrain terminal with a "feel" of an airport and to enable travelers to check their baggage as if they were entering the airport. The project design included such facilities, and they were built. However, after the terrorist attacks of September 11, 2001, changes in security procedures prevented them from being put to use, and these restrictions remain in effect indefinitely.

The project scope was modified in four significant ways, three of which did not directly affect the PA. First, as previously noted, the MTA and the PA agreed to improvements in the MTA LIRR station, which the PA agreed to fund in large part. Second, the MTA also decided to undertake improvements worth $12 million in the Howard Beach subway station. The enhancement of the intermodal transfer was part of the increase in the PA financed AirTrain project to $1.9 billion.) While the PA project included an AirTrain station adjacent to and connecting to this subway station, it did not include improvements to the subway station. The MTA altered its schedule for renovation of that station and the PA, on behalf of New York City Transit, made improvements in keeping with the timetable to open the AirTrain service. Originally scheduled to open by the end of 2002, opening was delayed until December 17, 2003 for reasons discussed below.

Two other scope expansions involved the New York State Department of Transportation (DOT). That agency owned the Van Wyck Expressway, the limited access highway whose median provided the base for the support structure for about three miles of the elevated AirTrain route. During the construction of this part of the route at least one lane of the road was required to be closed. During this phase of the work the DOT decided to expand the width of the highway shoulders to improve safety and better accommodate traffic in the future, replace two bridges, and improve highway on and off ramps. This work was completed via a negotiated amendment to the AirTrain contract and had a cost of $34 million.

Shortly thereafter, the DOT also decided to widen six bridges crossing the Van Wyck; this separate contract cost the DOT about $72 million – about $12 million per bridge. Since the construction of the AirTrain would require temporary closure of lanes on the Van Wyck and construction of AirTrain impacted repavement of roadway segments, the DOT decided that it would be less impact on the community and less costly if their bridge work was done simultaneously to the AirTrain construction. In addition, by using the PA's contractor, they saved the time of a procurement process. While this bridge work was not essential to the AirTrain project, the work was combined with the AirTrain contract and can be viewed as part of the related improvements.

Schedule. Service to both the Howard Beach and Jamaica stations began operation in December 2003. This represented a delay from the initial schedule of about one year for the Howard Beach service and about six months for the Jamaica service.

The change and delay in completion was due almost exclusively to an accident on September 21, 2002 during the testing of the AirTrain cars. As of 2002, the project was on schedule, with the supporting structures and track route virtually completed and the initial equipment delivered for testing. However, during testing a train crashed due to excessive speed on a curved section of track while being manually operated during a test run, and the resulting crash killed the person operating the test train.

In response to the fatal accident, testing was postponed during an investigation and then new testing procedures that required additional time were implemented. This led to revising the schedule for opening service so that both services would open together and the target date was delayed until late 2003.

The investigation into the accident revealed that it resulted from human error rather than faulty equipment. The tests required that weights be put in the cars to simulate a full load of passengers. The weights on the tragic day were not secured to the floor of the car. When the train stopped abruptly upon crashing, the weights dislodged and were propelled forward and crushed the operator. Redesign of the equipment was not required and the project moved forward relatively rapidly once new test procedures were established.

Volume and Revenue. The AirTrain was expected to have a daily average of 11,000 revenue passengers in the first year of operation. The project reached this volume after about four years of operation, as shown below:

Year	Total	Howard Beach	Jamaica
2004	7,117	3,431	3,683
2005	9,339	3,756	5,615
2006	10,834	3,967	6,870
2007	12,105	4,368	7,737
2008	13,860	4,851	9,009

The fare was established at $5 for airline passengers and a discounted $30/month for employees and frequent fliers, and these fares have remained in effect to date. Given the initial lower than expected paid ridership, revenues in the initial years also were below target. The PA likely was required to subsidize the operation in its early years at a level somewhat above its initial plan.

SUSTAINABLE DEVELOPMENT CHALLENGES

Consistent with state and federal law, the PA had prepared and federal authorities reviewed an Environmental Impact Statement (EIS) indicating the environmental consequences of the planned project. This document covered 24 separate aspects of environmental consequences plus a consideration of the "cumulative impact" of these 24 elements. The separate aspects assessed are: traffic, noise and vibration, air quality, surface water quality, groundwater, solid waste, wetlands, floodplains, aquatic biota, construction, visual resources, coastal zone, energy, light emissions, ecology, wild and scenic rivers, parkland, cultural resources, hazardous sites/material, farmland, geology and soils, topography, electromagnetic fields, and environmental justice.

The EIS came to this overall conclusion: "The environmental consequences associated with the LRS are relatively minor and can be mitigated." Specific findings related to separate items included: "VMT [vehicle miles travelled] on regional highways will be reduced,…No noise or vibration impacts will occur,…Air quality impacts are acceptable…Wetland impacts have been avoided to the maximum extent practicable…The loss of less than one-half acre of wetland can be mitigated on site…Potential minor impacts to source water, ground water, aquatic biota and geology an soil can be mitigated, primarily through sound construction and operation practices and the installation of drainage…Relatively minor impacts to floodplains, vegetation and wildlife can be mitigated through design, minimizing the size and location of certain construction activity, and the replacement of vegetation after the construction phase of the project." (EIS, page S-45).

The current concern with greenhouse gas emissions and global warming was not required to be explicitly addressed in the federally mandated analysis, but a major element of this issue was considered in the "energy" section of the analysis. It estimated that 1.38 trillion BTUs will be needed to construct the system, and 51.1 billion BTUs needed annually to

operate the system. The net savings due to the expected reduction in VMT from use of the AirTrain was estimated at 75.1 billion BTUs annually. This suggested a "payback period" in terms of energy savings of under 20 years. Federal standard set a payback period of under 20 years as acceptable, and the analysis stated: "Mitigation for consumptive use of gasoline and energy is not warranted." (EIS, page S-32.)

The estimate of energy savings was based on the PA's planning assumption of annual passenger volume growing at about 2.5 percent annually. The long-term purpose of the project was to make this volume growth more feasible by reducing travel congestion in reaching the airport. The energy analysis did not take into account the increased energy use related to steadily growing airline passenger volume. Such broader issues of the relationship of the project to total energy use by all modes (and overall volume) of travel were not part of the analysis.

TREATMENT OF RISK, UNCERTAINTY, COMPLEXITY AND CONTEXT

Four important points can be made about how the AirTrain project managers coped with the risk and uncertainty associated with megaprojects.

1. Risks related to technological innovation were avoided by using proven technology for the system.
2. The use of a 'design, build, operate and maintain" (DBOM) contract successfully managed risks associated with cost escalation.
3. Risk related to revenue projections were fully absorbed by the PA out of necessity, but this did not prove to be a major problem.
4. The organizational complexity associated with building a project that required crossing "silos" separating air, rail and highway modes (a feature of the U.S. context) was successfully handled only by having a high level political champion, critical interagency cooperation and coordination at both executive and working levels and, when required, skillful negotiation by a designated official.

Technology Risks. The PA's request for proposals from contractors did not specify the technology to be used for the system. Among the bids received from the five pre-qualified organizations, the proposed technologies varied somewhat. In selecting among the bidders, the PA decided not to use the most advanced technology for which experience was limited. Instead they opted for a proposal that included technology in use around the globe. This was true for the automatic train control system, and the vehicle technology with its linear induction motor was also in service in several urban systems, most notably Vancouver, British Columbia. This decision was rooted in a concern for delays that might arise in using technology that was not already proven.

The advantages of using existing technology are illustrated in the way PA officials used existing versions of the AirTrain design to deal with potential objections about noise and other features from local residents. Port Authority officials organized two trips for local elected officials from Howard Beach and Jamaica to Vancouver, Canada, which has a Skytrain, similar to AirTrain and built by the same company (Bombardier). Port

Authority staff arranged conversations directly under the train, to then inform the surprised skeptical local politicians that a train had just passed by, thus removing their noise impact objections.

Expense Risks. The PA's use of a DBOM contract was unusual for the PA and for other public entities in the United States. The more conventional approach is for the public agency to complete the design either in-house or with a separate design contract, and then to solicit bids for construction of the pre-designed project. The sponsoring public agency also generally takes responsibility for maintaining and operating the facility.

The PA's decision to deviate from the conventional approach was based on multiple considerations. First, they believed combining the design and build (DB) responsibilities would speed completion and reduce cost overruns. The DB model for a contract has had favorable experience in achieving these objectives. The PA completed about 10 percent of the design work, including design of the tunnel on the airport grounds, but felt an outside party with more relevant expertise might be better qualified to complete design features for the rest of the system.

The decision to expand from a DB to a DBOM contract took additional factors into account. This approach would create incentives to design a system that was cost-effective to maintain, whereas a DB model might leave the PA with a system that was highly expensive to maintain. Thus, this approach reduced the risks of high maintenance costs.

Perhaps equally important, the PA was not eager to take on operational responsibilities. Most of the PA's facilities are operated by other parties; specifically most airport terminals are operated by airlines and/or other third parties, and its parking facilities also are franchise operated. The PA maintains a relatively lean workforce at the airports. It did not want to expand significantly its operational responsibilities, and this was especially true for a mass transit-like operation. In New York, the mass transit system operated by the Metropolitan Transportation Authority is unionized and characterized by sometimes difficult labor relations. The PA was not eager to get involved in these issues. Thus it sought a DBOM approach in order to deal with multiple issues, not just reducing the risks of unanticipated construction and maintenance costs.

The contract awarded required designing and building the system and operating it for the first five years. There then were two five-year options for renewal of maintenance and operation. The first option was at the discretion only of the Port Authority; the second option required agreement from both parties.

Another successful feature of the contract was inclusion of a $129 million contingency fund for the construction costs. This contingency fund was available to cover unanticipated costs, and as an incentive to avoid its use the contract allowed the private consortium to keep 40 percent of any unused portion of the fund. This helped contain unanticipated costs and avoided delays due to conflicts over such costs. At the end of the contract about $30 million of the reserve remained unused and the contractor received abut $12 million.

Revenue risks. The controversy over the failure of the design to include a "one seat" ride to Manhattan led to considerable uncertainty over the ridership and revenue projections. Many observers feared very low use due to the inconvenience. Preliminary discussions with potential contractors indicated they would be either unwilling or would attach a significant cost premium to accepting the ridership and revenue risks. In response, the PA decided to assume all the revenue risks. The DBOM contract did not include responsibility for fare collection and did not allocate revenues collected to the consortium. Instead, the PA developed a working relationship with the MTA for fare collection at the Jamaica and Howard Beach terminals, and the PA assumed the risk that projected revenues would materialize.

As indicated in the previous section, ridership did not meet projected levels in the first few years. The PA did suffer some revenue shortfall, but the cost was modest relative to the entire project cost, and the PA was able to absorb this cost in its overall budget. In addition, enhanced post 9/11 security requirements have added to PA costs for system operation.

Complexity. The most troublesome complexity associated with the AirTrain project was the need to obtain cooperation among multiple agencies. The PA required cooperation from the MTA in order to effectively connect the AirTrain to facilities at the Jamaica and Howard Beach terminals, and cooperation from the New York State Department of Transportation in order to gain access to the right of way along the Van Wyck Expressway.

The mechanism for achieving this cooperation was involvement of the Governor of New York State. Governor George Pataki was elected in 1994. He urged development of a compromise solution for the AirTrain project and was eager to have the project completed during his tenure. (Pataki was re-elected in 1998 and 2002.) He had influence with three agencies involved because he appointed (along with the Governor of New Jersey) board members of the PA and its CEO. He also appointed board members to the MTA and its CEO. In addition he directly appointed the Commissioner of the State Transportation Department.

Pataki wanted a link to JFK airport built while he was in office and pushed the project with the PA board. He also proved willing to intervene with the agencies in order to speed implementation. Specifically, when negotiations between the PA and the MTA bogged down over the sharing of the cost for improvements at the Jamaica terminal, Pataki urged the MTA Chairman to resolve the issue speedily. This led to the MTA Chairman designating a senior staff member to develop a compromise. She convened meetings between staff of the two agencies and worked to achieve an acceptable compromise. The clear signal that the Governor wanted the issue resolved and the negotiating skills of the designated representative were critical to dealing with this complexity.

This type of complexity is rooted in the organizational context of the U.S. transportation system. The system is characterized by modal "silos" in which single modes of transportation are handled by separate agencies; planning and funding across the agencies is extremely difficult. This was a serious issue for the PA in developing the AirTrain, and the related issues were resolved in a timely way because of the involvement of high level political officials. In addition, the high visibility of the project put pressure on the senior officials of the agencies to cooperate.

LESSONS LEARNED

The AirTrain as a case study suggests five conclusions or lessons that may be generalizable.

1. *Objectives related to economic growth outweigh other considerations in building political support for a project*. The primary goal of the AirTrain was to facilitate access to JFK airport, and this was deemed desirable because of the airport's role in the regional economy. A fear of loss in potential growth and market share for passenger and freight volume at JFK was the major motivation for the project.
2. *Existing environmental review procedures adequately assess many threats to environmental sustainability, but they do not address the impacts of economic growth.* The environmental review process (EIS) in the U.S. considers, and requires mitigation for, many harmful impacts, but the process assumes objectives of economic growth and does not require alterations to economic growth objectives. In the case of the AirTrain, the EIS considered options for accommodating growth in air travel, and it did not question the need for such growth.
3. *The project financing sources have a significant influence on project design*. The amount of funds available shape the scale of the project, and the categorical sources of funding may shape the specific design features. In the case of the AirTrain, the use of the PFC as a major financing source made the project financially feasible but also, with other factors, contributed to compromises and a scaling back of the project from the initial 22 mile design.
4. *A DBOM contract can be an effective mechanism for controlling risks associated with construction and maintenance costs.* In the case of the AirTrain, the PA used this device to keep costs close to budgeted amounts.
5. *A high level political champion willing to use the powers of their office on behalf of the project may be necessary for successful implementation of mega-projects.* Timely completion of the AirTrain required leadership from the Governor in order to assure the necessary multi-agency cooperation, and to assure that any interagency disagreements were resolved expeditiously.

List of Abbreviations:

AGT	Automated Guideway Transit
BTU	British Thermal Units
DB	Design-Build
DBOM	Design-Build-Operate-Maintain
DOT	Department of Transportation
EIS	Environmental Impact Statement
FAA	Federal Aviation Administration
JFK	John F. Kennedy (International Airport)
LIRR	Long Island Railroad
LRS	Light Rail System
MTA	Metropolitan Transportation Authority
NYCT	New York City Transit
PA	Port Authority of New York and New Jersey
PFC	Passenger Facility Charge