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TASK FORCE DELAY STUDY. WILLIAM B. HARTSFIELD ATLANTA INTERNATI--ETC(U)
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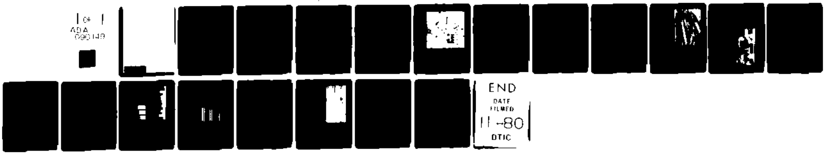

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16. Abstract

This report presents the results of a detailed analysis of the William B. Hartsfield Atlanta International Airport. The analysis was conducted by the Atlanta Airport Improvement Working Group which had representatives from the City of Atlanta, the Air Transport Association, the airlines serving Atlanta, and the Federal Aviation Administration. The purpose of the analyis was to determine the causes of delay and the potential delay reduction benefits of recommended improvements. The effort was part of the Airport Improvement Program.

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Preface

The study of air traffic delay at the William B. Hartsfield Atlanta International Airport was conducted by a Task Force composed of representatives of the Federal Aviation Administration (FAA), the airlines serving Atlanta, the Air Transport Association and airport management officials of the City of Atlanta. Support to the Task Force was provided by the FAA Washington Headquarters organizations and consultants from the MITRE Corporation and Peat, Marwick, Mitchell & Co.

The Task Force studied the problems causing current delays, identified the extent of future delays and estimated the order-of-magnitude of potential benefits that could be gained from various improvements. The resulting information should be helpful in future decisionmaking.

The improvements that offer the greatest potential benefits, such as the addition of a fourth runway and reduction of separation standards, will require large capital investments and technological development efforts. Operational improvements and changes in scheduled demand (the rescheduling of aircraft operations more uniformly throughout the day), which are less costly, offer smaller but still significant reduction in delays.

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Introduction

Background

The William B. Hartsfield Atlanta International Airport plays a vital role in the nation's air transportation system. More than 16 million airline passengers were enplaned at Atlanta in 1978.

During the 12-month period from July 1, 1977, through June 30, 1978, the airport handled 534,586 aircraft operations. This level of activity resulted in about 40,090 hours of aircraft delays, averaging about 4.5 minutes of delay per operation, as estimated using the FAA annual delay model. Assuming an average aircraft operating cost of $17 per minute, the cost of the delays was approximately $40.9 million.

These delays resulted in the excess consumption of about 41.3 million gallons of aviation fuel, untold hours of lost passenger time, and airfield congestion that placed additional burdens on the air traffic control system.

The new midfield terminal complex, which is scheduled to be in operation in late 1980, will increase airport efficiency and reduce overall aircraft delay. Nevertheless, additional airfield and airspace improvements will be necessary to meet a 1987 demand of 753,300 aircraft operations, as forecasted for this study by the Task Force. The FAA forecast of August 1978 estimated the total operations would reach only 720,000 in 1990. The City of Atlanta forecasts that total operations will reach 720,000 in 1987. Regardless of the forecast used, the amount of delays will increase dramatically unless significant improvements are made.

Individual judgment should be applied in the use of the delay estimates in this study. The delay levels included in this study are predicated on the forecast levels developed by the Task Force, and may shift along a time continuum, depending on where the predicted activity levels are actually reached. Also, certain separation reductions may not be achieved in the time frame that was assumed.

The Task Force investigated several improvement options that offer the potential of providing the needed balance between demand and capacity. These options are discussed in the remainder of the report.

Objectives

The objectives of the Task Force were:

To determine current airport capacity and aircraft delays and to identify the causes of delays associated with terminal airspace and with airfield and apron-gate area operations.

To determine the capacity increases and delay reduction benefits of alternative improvements for immediate, short-term (1982) and long-term (1987) implementation. These improvements involve Air Traffic Control (ATC) procedures; Facilities and Equipment

(F&E) funded by the FAA; improvements funded by the Airport Development Aid Program (ADAP); and products of the FAA Research, Engineering and Development (RE&D) program.

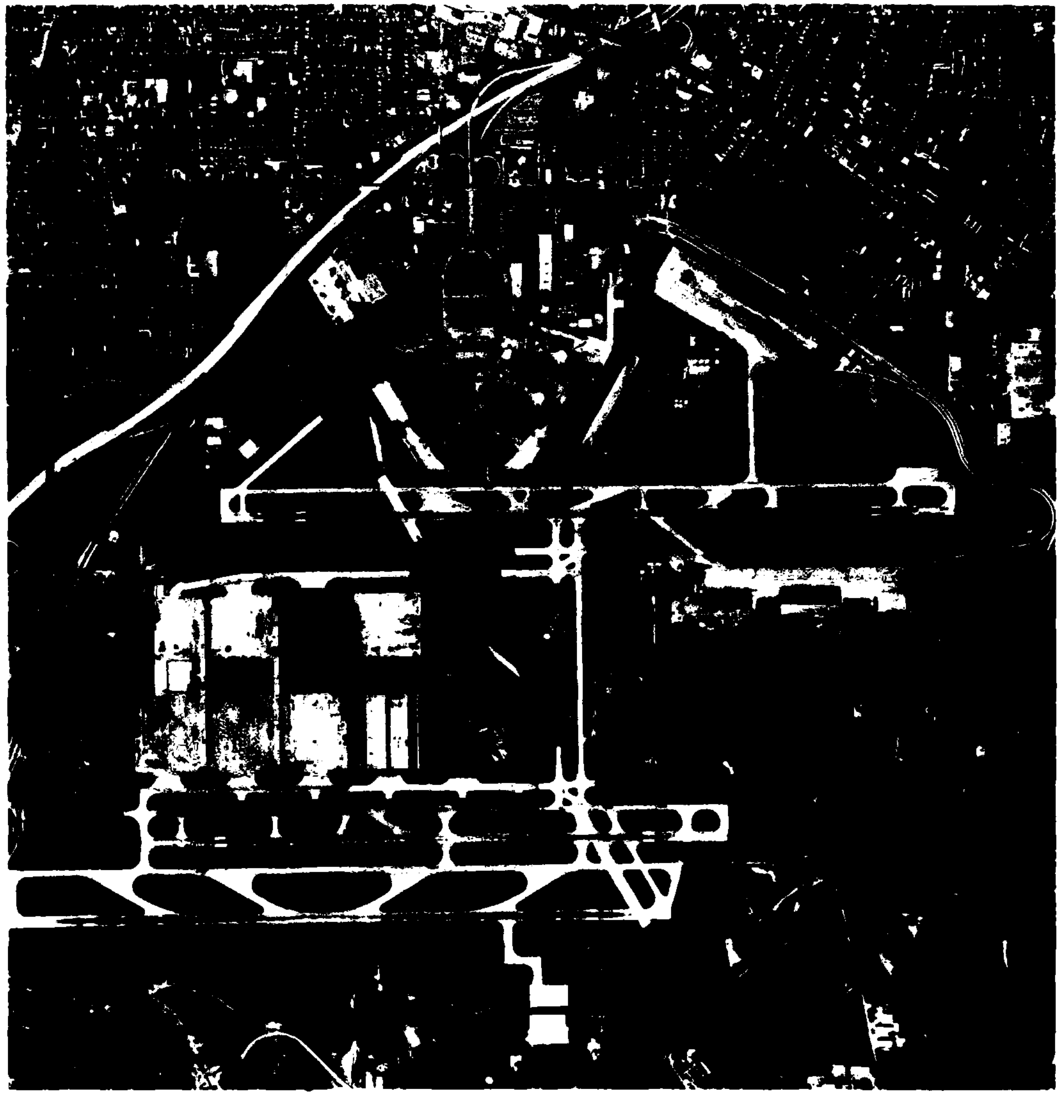
To determine relationship between air traffic demand and delay in the present and future time periods as an aid to establishing acceptable air traffic movement levels.

Scope

The Task Force limited its analyses to the aircraft activity within the Atlanta Terminal Area Airspace and the aircraft operations on the airside of the airfield. Attention was given to potential delay reductions and capacity increases offered by airport improvements, ATC procedural changes, reduced separations, and airport use policies.

It was recognized that real problems are associated with the groundside of the airport operation and that environmental concerns must be considered, but these were beyond the scope of the Task Force's charter. Such issues should be considered in-depth, however, in future airport master planning.

The data developed by this study should serve as an important input in such future master planning.



Recommended Improvements

Based on the data developed in this study, the Task Force recommends the 21 improvements listed below as essential to meet future demand without excessive delays. The status of each improvement, as of February 1980, is shown.

The presently approved Airport Layout Plan states the new runway would be used basically for departure operations. Data developed during this study show an increase in airport capacity could be realized if the new runway was fully instrumented. The use of the future Runway 08L/26R, with full instrumentation, will be considered during the environmental impact assessment studies presently underway and the future Environmental Impact Statement and public hearing process.

Four general categories of recommended improvements offer the potential for increasing airport capacity and reducing aircraft delays:

- Airfield Improvements
- Additional Facilities and Equipment Improvements
- Air Traffic Control Operational Improvements
- Airport User Improvements

These improvements are summarized in Exhibit 1 and are discussed briefly in the following text.

Airfield Improvements

Major airport improvements are essential if the 1987 demand is to be accommodated without excessive delay.

A1. Complete Construction of Midfield Terminal Complex—Potential Savings (1982 Activity Level)—$26,000,000 Annually
The midfield terminal area complex and associated taxiway system expansion improvements are under construction and scheduled to be operational in September 1980.

A2. Construct Fourth Parallel Runway 08L/26R—Potential Saving (1987 Activity Level)—$115,000,000 Annually.
Planning for a fourth runway and associated improvements has reached the environmental assessment stage.

A3. Extend Runway 09L/27R
The high-gross weight international flights departing from Atlanta Airport now take off from Runway 08/26 on the north side of the airfield because of its greater length. A 3,889-foot extension to Runway 09L/27R will provide the capability to use the south side of the airport for international flights also. In addition, this extension will provide the flexibility that the airport needs to accommodate the expected growth in international traffic which otherwise will generate additional aircraft delay.

Planning for the runway extension and associated improvements has reached the environmental assessment stage.

Facility and Equipment Improvements

B1. Expedite Development of Wake Vortex Advisory and Avoidance Systems—Potential Savings—Near-Term (1982)—$15,100,000 Annually Far-Term (1987)—$155,000,000 Annually.
The WVAS is envisioned as a ground based predictive system which will allow decreased longitudinal spacing between aircraft when wake vortices do not present a hazard to following aircraft. The WVAS and other ATC programs, such as Metering and Spacing, are required to achieve the reduced separation standards.

B2. Establish Category III—A ILS on Runway 08—Potential Savings (1982—$800,000 Annually.
Airport operates in an easterly mode when the visibility drops below 2,400 feet, Runway Visual Range (RVR). Runway 09R is the only runway instrumented to handle arrivals with less than 1,600 feet RVR. Installation of Category III-A capability on Runway 08 would increase airport capacity by permitting a dual arrival stream when visibility is as low as 700 feet RVR.

B3. Establish MALSR on Runway 09L
A Medium Intensity Approach Light System with Runway Alignment Indicator Lights on Runway 09L is funded but installation is being deferred until Runway 09L is extended.

Exhibit 1 Recommended Improvements

No.	Improvement	Potential annual savings
Airfield Improvements		
A1	Complete Construction of Midfield Terminal	$ 26 million (1982)
A2	Construct 4th Parallel Runway 08L/26R	$115 million (1987)
A3	Extend Runway 09L/27R	
Facilities and Equipment Improvements		
B1	Expedite development of wake vortex advisory and avoidance systems	$115 million (1987)
B2	Establish Category III-A ILS on Runway 08	$ .8 million (1982)
B3	Establish MALSR on Runway 09L	
B4	Establish ILS/MALSR on Runway 27R	
B5	Establish DME on all ILSs	
B6	Establish 2nd ASR	
B7	Establish ASDE with tracking	
B8	Establish ILS/MALSR on Runway 26R	
B9	Establish permanent site for Atlanta VORTAC	
B10	Establish 2nd BANS in ATCT	
B11	Remote Center radar to Tower TRACON	
B12	Remote Tower radar to Atlanta Center	
Operational Improvements		
C1	Refine gatehold procedures	
C2	Develop reduced separation procedures	
C3	Use dual departure tracks	
C4	Implement automatic metering and spacing	
User Improvements		
D1	Reduce peak-hour demand	
D2	Improve aircraft mix	

B4. Establish ILS/MALSR on Runway 27R
A Category I Instrument Landing System and Medium Intensity Approach Light System with Runway Alignment Indicator Lights on Runway 27R is funded. The ILS is scheduled to be commissioned in early 1982, but the MALSR is being deferred until Runway 27R is extended.

B5. Establish DME For All ILSs
The constant readout of distance-to-touchdown, as provided by DME, will enable the pilot to more precisely control the operation of his airplane while conducting approaches. This feature will be particularly advantageous during Category II simultaneous ILS operations. The distance information will enhance the capability to make precise speed adjustment which will become more critical as separation standards are reduced. No analysis was made to quantify the benefits that will accrue; however, the capability should positively benefit the capacity/delay problem at the airport. The DME for Runway 08 is commissioned. The DME for Runway 09R is funded and scheduled for commissioning in late 1980. The DME for the other runways should be considered in future FAA Budget requests.

B6. Establish 2nd ASR
The Atlanta area is continually saturated with aviation activity that is dependent on a single ASR system. Failure of the radar system would create a chaotic and completely intolerable situation.

Should the radar fail for any reason, airport capacity would be reduced to 30 operations per hour. An extended outage would cause serious aircraft diversions, completely disrupt air traffic in the Atlanta area and, by chain reaction, detrimentally affect many U.S. air routes and other terminal areas. A project is funded and the radar is expected to be commissioned during the summer of 1980.

B7. Establish ASDE with Tracking
The installation of Airport Surface Detection Equipment (ASDE), capable of displaying a data tag, will significantly improve airport ground operations. It will increase capability for an orderly, flow of ground traffic during all types of weather by assisting ground controllers in maintaining positive identification on all aircraft.

B8. Establish ILS/MALSR on Runway 26R
Category I ILS on Runway 26R will provide redundancy (i.e., backup) for westerly simultaneous operations under IFR conditions when Runway 26L is not available. The airport operates in a westerly configuration approximately 60 percent of the time.

B9. Permanent Site for Atlanta VORTAC
The Atlanta VORTAC is located on a temporary site on the Atlanta Airport. The VORTAC will be needed in the navigational system in the future and a permanent site should be designated.

B10. Establish 2nd BANS in ATCT
The existing BRITE Alpha-Numeric System (BANS) is used operationally on a 10-mile expanded range. It provides tower controllers the greatest possible target resolution for quick analyses of traffic situations. This information helps the controllers to make more rapid and effective decisions on runway crossings and arrival/departure interface. A second BANS is needed to allow the controllers to select a larger range which will display a broader picture of the traffic situation. The additional information will help the controller plan a more efficient long range (4 to 15 minutes) runway utilization strategy and reduce delays.

B11. Remote Center Radar to Tower TRACON
The Atlanta Center and Atlanta Tower implemented manual traffic metering (Terminal Area Flow Procedures) over the Center inner arrival fixes in 1975.

The ultimate goal is to accommodate zero thrust descent profiles from en route cruising altitude to touchdown. To achieve this objective, adjustments to aircraft spacing must be accomplished during peak traffic periods well outside terminal jurisdiction. Balanced traffic flow and speed restrictions are key factors to efficient service, consistent with traffic, airport, NAVAIDS and weather conditions.

Constant verbal communication between Center Flow Controllers and Terminal Arrival Coordinators is now necessary to conduct operations. A visual display that provides the Terminal Arrival Coordinator with the same information available to the Center Flow Controllers would be invaluable during peak traffic, severe or Category II weather, and changes in landing directions.

This option will be a valuable aid to terminal area metering and spacing which is now being developed. Also, it will provide additional radar backup for the Atlanta Terminal Area.

No attempt was made to quantify the capacity/delay benefits that would accrue by remoting the radar data from the Atlanta Center radar to the Atlanta Tower TRACON. However, those experienced in the control of the Atlanta traffic believe this would enhance the controllers' level of confidence and provide an additional margin of safety, especially when aircraft separation standards are reduced.

B12. Remote Atlanta Tower Radar to Atlanta Center

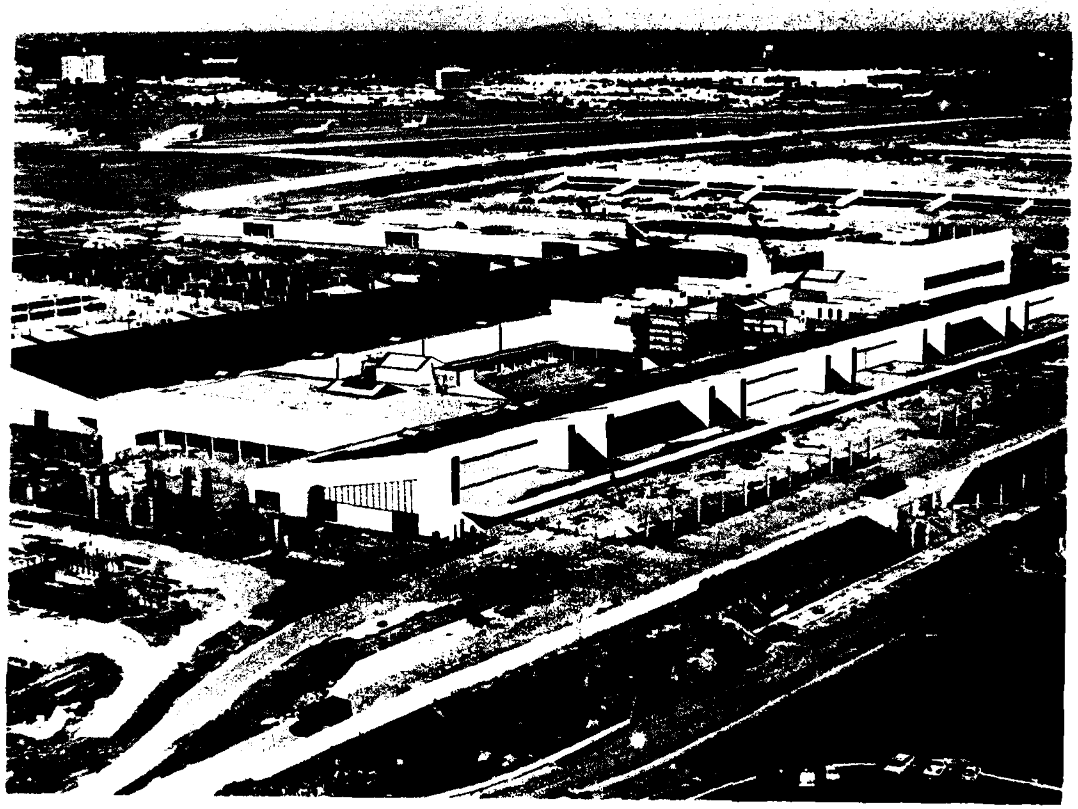
The Atlanta Air Route Surveillance Radar (ARSR) site is located in the middle of the Atlanta North Departure Sector. When using broadband radar, radar contact is lost during a critical phase of control; namely, transfer from Tower to Center. When Atlanta is on a west operation with a right turnout to the north, this condition adversely affects the departure rate.

When using narrowband radar, this problem is compounded by the computer's inability to track targets. When the correct target reappears, the data block jumps to the target and commences tracking again. Data block jumps of 20–30 miles have been noted. This forces the controller to continuously confirm aircraft identity to insure proper tracking.

When the Atlanta ARSR is out of service, there is no adequate backup system because of the distance between it and the other ARSR sites. There is no ARSR coverage below 11,000 feet in the Atlanta Terminal Area. Arrival and departure delays are incurred due to implementation of nonradar procedures. There are two exceptions: (1) turbojet arrivals that cross the arrival fixes at or above 12,000 feet and (2) turbojet departures that can climb above 10,000 feet in Tower airspace prior to radar handoff. The Flow Controller is unable to monitor the arrivals from the fix to the airport and, therefore, is unable to assist the Atlanta Tower in traffic management.

Constant coordination is necessary between the Center Flow Controller and Terminal Arrival Coordinators in conducting present operations. Visual displays that provide the Center Flow Controller with all information available to the Terminal Arrival Coordinators would prove invaluable during peak traffic, severe or Category II weather, and changes in landing directions.

No attempt was made to quantify the degree of improvements that would be gained from this option. However, the Task Force recommends that it be studied in depth and implemented if it proves to be technically and economically justifiable.



Operational Improvements

C1. Refine Gatehold Procedures
An experiment was performed to show the benefits of gatehold procedures. The elimination of gatehold is shown to have very little effect on runway delays. However, the potential benefits from fuel savings and reduced taxiway congestion are valid reasons to retain and refine the procedures.

C2. Develop Reduced Separation Procedures
Current ATC procedures permit 2.0 nautical miles staggered approaches when simultaneous approaches are not authorized. Three experiments were performed to compare the effects of reduced separations on arrival delays.

Arrival delays with 2.0 nautical miles staggered approaches are about double the delays with independent approaches. Delays with 1.5 nautical miles staggered approaches fall approximately halfway between the other two cases.

C3. Use Dual Departure Procedures
Present noise abatement procedures require aircraft departing from either Runway 08 or Runway 09L fly a common heading from each runway (70° for Runway 08 and 105° for Runway 09L) for five miles after takeoff or until reaching an elevation of 5,000 feet.

The use of dual departure tracks on Runway 09L would reduce peak-hour delays by about one minute per operation.

C4. Implement Automated Metering and Spacing
The FAA has a metering and spacing program in development.

Airport User Improvements

Airport congestion delays occur when traffic demands exceed the available airfield capacity. The primary control that airport users have over delays is to adjust and/or limit their demand.

D1. Reduce Peak-Hour Demand Resulting from Scheduling Methods

The major airlines serving Atlanta have initiated depeaking practices—the rescheduling of aircraft operations more uniformly throughout the day—on a unilateral basis. Significant changes in schedules have been made, and the schedules are under continuing review by the airlines. It might be possible for the Atlanta Airport management and the FAA to meet with the airlines individually to discuss schedule peaking problems and their effects on delays. An organized depeaking effort offers a high potential for an immediate and sustained delay reduction. The Task Force recommends that a computer model for schedule depeaking be developed.

D2. Improve Aircraft Mix

Under present procedures, all aircraft are entered into the traffic flow, in turn, without regard to size, weight, or speed characteristics. Separation intervals between adjacent aircraft are predicated on these characteristics. For example, requirements for separations between small and large aircraft are greater than the requirements for separation of aircraft in the same category. The intermingling of aircraft of various sizes reduces the number of operations that can be accomplished within a given time period, as compared with a steady stream of similar types of aircraft. Legislative or rulemaking action will probably be needed to implement operational procedures that restrict the use of a federally aided airport by any member of the flying public.

Several options appear to be available for reducing delays by modifying the aircraft mix. For example: (1) segregate aircraft by weight and speed characteristics; (2) restrict operations of certain classes of aircraft during certain periods of the day; (3) segregate aircraft by runway assignments; and (4) provide a reliever airport or separate runway for smaller aircraft. Although the precise effects of these improvements have not been demonstrated in actual practice, the Task Force recommends that all of them be investigated in detail.

Summary of Technical Studies

The operation of the existing airfield and the potential benefits of the improvements were assessed in terms of airfield capacity, airfield demand, and average aircraft delays. Estimates of average aircraft delays are based on the values—and the interrelationships of airfield capacity and demand. The estimated average aircraft delays permit assessment of both the operational feasibility of the airfield and the potential economic benefits of improvements.

Various airfield system improvements, ranging from changes in air traffic control procedures to changes in physical facilities and operations can increase airfield capacity and thus reduce delays. If a dollar value is attached to each minute of average aircraft delay, the cost of a particular airfield improvement can be weighed against its annual delay savings. Thus, a comparison of the costs and the delay reduction associated with each of the various improvements indicate which are the most effective. For a given forecast increase in demand, a suitable combination of airfield improvements can be implemented in stages so that airfield capacity is increased as needed and average aircraft delays are maintained within acceptable limits.

The following paragraphs summarize the technical studies. First, present-day operations at the Airport are briefly described. Then, estimates of present and projected airfield demand, airfield capacity, and average aircraft delay are presented. Next, the airfield capacity increases and the aircraft delay reductions associated with the recommended

Exhibit 2 Airfield Operations

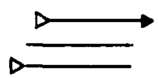
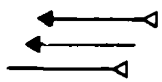
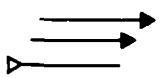
Weather	Visibility / ceiling	Percentage occurrence
VFR	3 miles / 1,000 feet	88.6
IFR1	Runway Visual Range (RVR) at least: 1,600 feet for east flow 2,400 feet for west flow	10.4
IFR2	Runway Visual Range between 700 feet and less than 1,600 feet (east flow only)	1.0

improvements are illustrated. Finally, the interrelationship of airfield demand, airfield capacity, and aircraft delays is examined.

Runway Configurations

Exhibit 2 illustrates the runway configurations used at the airport and presents the average percentage utilization of these configurations in different weather conditions.

Exhibit 2 Airfield Operations (continued)

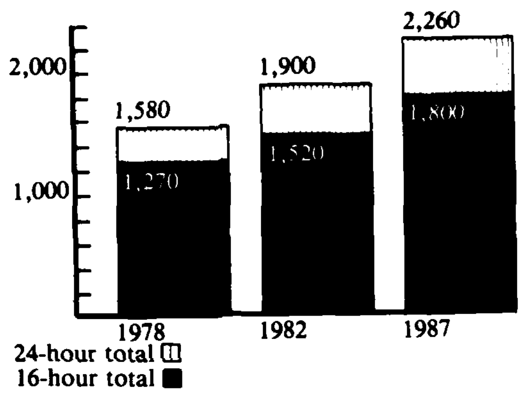
Runway Use	Configuration	Percentage use (1978 Baseline)			
		VFR	IFR1	IFR2	Total all weather
1		6.3	4.2	0.0	10.5
2		53.1	35.4	0.0	88.5
3		0.0	0.0	1.0	1.0
Total		**59.4**	**39.6**	**1.0**	**100.0**

Airfield Demand

Exhibit 3 illustrates projected increases in annual demand from 534,586 aircraft operations (landings and takeoffs) in 1978 to 753,300 in 1987, and corresponding increases in daily peak hour traffic.

Exhibit 3 Airfield Demand Levels

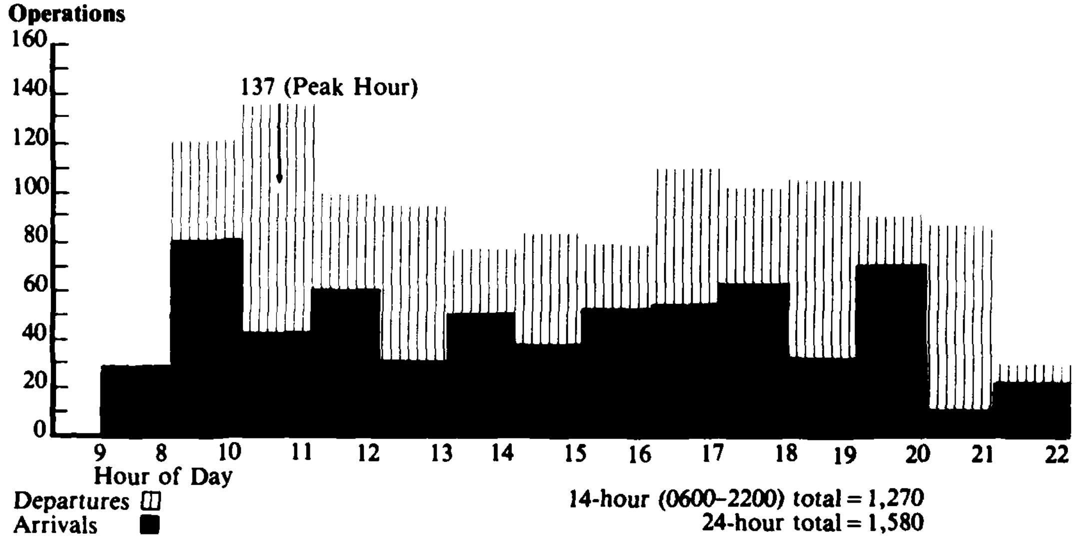
Average Day, Peak Month Demand



Aircraft operations

	Annual	24-hour day (average day, peak month)	Peak hour
1978	534,586	1,580	137
1982	633,300	1,900	151
1987	753,300	2,260	182

Hourly Variation of 1976 Demand (Average Day, Peak Month)



Airfield Capacity

Airfield capacity is the maximum number of aircraft operations (landings or takeoffs) that can be processed in a given time under specific conditions of:

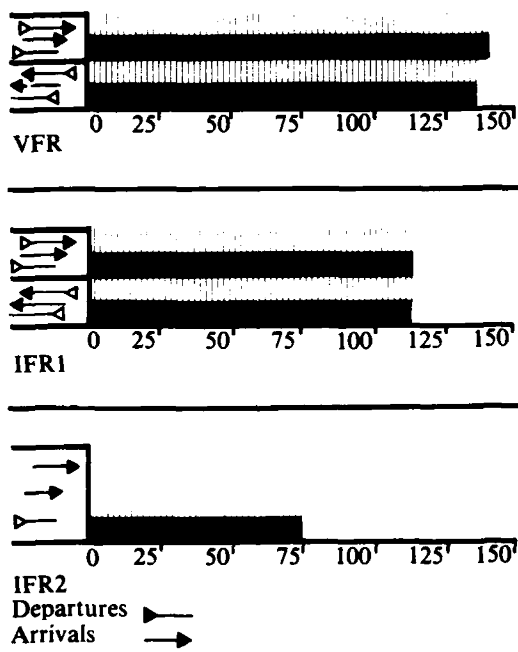
- Airspace constraints
- Ceiling and visibility conditions
- Runway layout and use
- Aircraft mix (types of aircraft)
- Percent arrivals

Airfield capacity is normally expressed on an hourly basis.

Exhibit 4 shows estimates of airfield capacity for the runway configuration and weather conditions defined in Exhibit 3.

Exhibit 4 Airfield Capacity

1978 Baseline Capacity (Operations Per Hour) (50% Arrivals)



Airfield Delays

Airfield delay is the additional travel time, caused by airfield congestion, taken by an aircraft to move from point A to point B. Computing average annual airfield delays involves:

- Airfield physical characteristics
- Air traffic control procedures
- Aircraft operational characteristics
- Airfield demand
- Weather

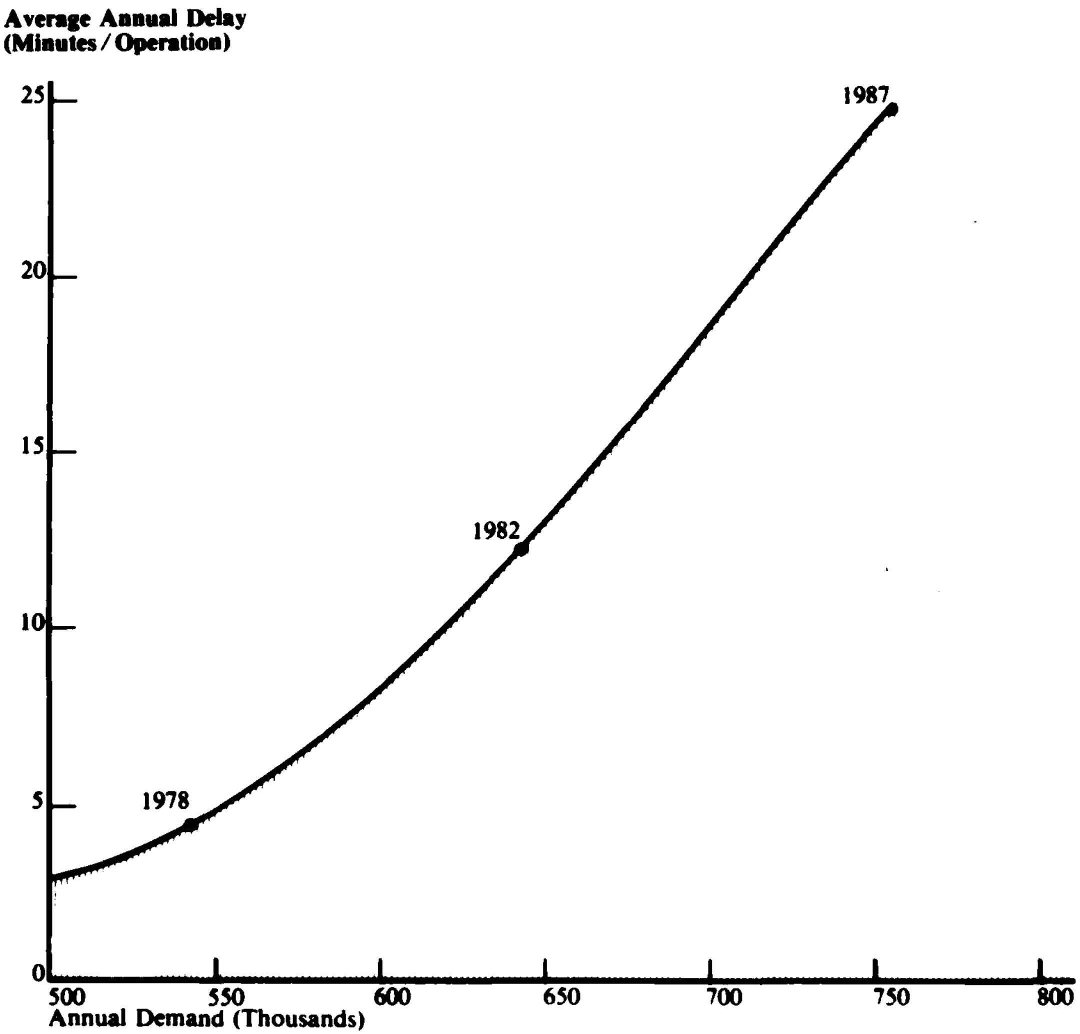
Average annual delays are expressed in minutes per aircraft operation.

Congestion results whenever the volume of aircraft operations at an airport approaches airfield capacity. Aircraft delays during congested periods are very high; and consequently the average aircraft annual delays are also high. High levels of congestion will prevail at Atlanta International Airport by 1987 unless airfield improvements and/or changes in air traffic control procedures are implemented to increase its capacity.

Exhibit 5 illustrates the increases in average annual delay that are estimated to occur in the future if no improvements are implemented.* If the improvements identified in Exhibit 1 are implemented, average annual delays would be significantly less than those identified in Exhibit 5, and annual delay cost savings in excess of $250 million could be achieved.

* NOTE. Under a "do nothing" situation the average delay in 1987 was estimated to exceed 41 minutes per operation. The Task Force recognized delay would not be allowed to reach this level unchecked and, therefore, assumed a maximum delay of 25 minutes per aircraft.

Exhibit 5 Estimated Annual Delay 1978–1987 (Do Nothing Situation)



Estimated Delay Savings

E&D improvement	Minutes per aircraft	Minutes per year	Costs per year at $17/minute
Near-term systems (1982)	1.4	886,600	$ 15,072,000
Far-term systems (1987)	12.1	9,114,900	$154,953,000

Impact of FAA Engineering and Development Programs

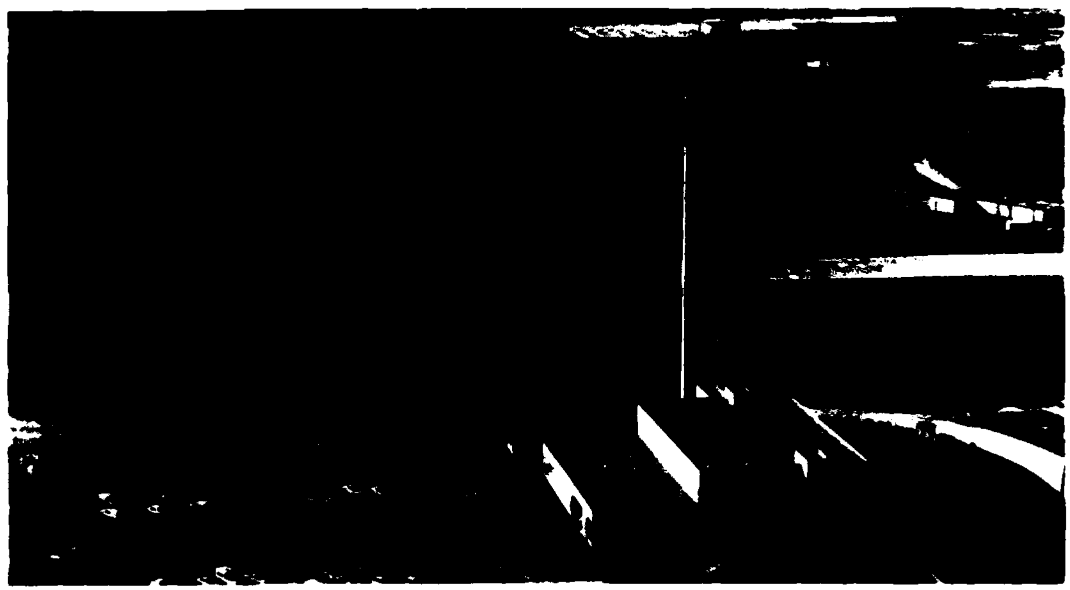
The Task Force also attempted to estimate the potential delay savings associated with FAA Engineering & Development (E&D) programs.

For purposes of analysis, the impact of the programs was identified by the FAA as being "near term" and "far term" according to the estimated time of availability. The "near term" programs were assumed to be operational at Atlanta in 1982; the "far term" in 1987.

For study purposes, the Task Force used the air traffic control operating parameters of these programs as given in the FAA report, "Parameters of Future ATC Systems Relating to Airport Capacity/Delay" (FAA-EM-78-8A), dated June 1978. Accordingly, the standard minimum IFR arrival/arrival separations were reduced from 3 nautical miles (nm) today and in the near-term, to 2nm in the far-term. The largest minimum arrival/arrival separation, e.g., for a small aircraft operating behind a heavy aircraft, was reduced from 6nm today to 4nm in the near-term and to 3nm in the far-term. The minimum departure/departure separation, which today ranges from 1 to 2 minutes, was not changed in the near-term but was reduced to 1 minute for all departure combinations in the far-term.

The evaluation is based on output from a computer model which produced average annual delay in minutes per aircraft movement in 1982 and 1987. Two cases were studied: (1) a base case with no improvements, and (2) a case in which the E&D systems were operating and **wake vortices were assumed absent 40 percent of the time in the near-term and 75 percent of the time in the far-term.**

In view of these results, the Task Force strongly supports the expeditious development of these systems.



Action Plan

No.	Improvement	Time frame: Short-range	Time frame: Intermediate range	Lead agency: FAA	Lead agency: Airlines	Lead agency: City
Airfield Improvements						
A1	Complete Construction of Midfield Terminal	●				●
A2	Construct 4th Parallel Runway 08L/26R		●			●
A3	Extend Runway 09L/27R		●			●
Facilities and Equipment Improvements						
B1	Expedite development of wake vortex advisory and avoidance systems	●	●	●		
B2	Establish Category III-A ILS on Runway 08	●		●		
B3	Establish MALSR on Runway 09L	●		●		
B4	Establish ILS/MALSR on Runway 27R	●		●		
B5	Establish DME on all ILSs	●		●		
B6	Establish 2nd ASR	●		●		

Action Plan (Continued)

No.	Improvement	Time frame: Short-range	Time frame: Intermediate range	Lead agency: FAA	Lead agency: Airlines	Lead agency: City
B7	Establish ASDE with tracking		●	●		
B8	Establish ILS/MALSR on Runway 26R		●	●		
B9	Establish permanent site for Atlanta VORTAC	●		●		●
B10	Establish 2nd BANS in ATCT	●		●		
B11	Remote Center radar to Atlanta Tower		●	●		
B12	Remote Tower radar to Atlanta Center		●	●		
Operational Improvements						
C1	Refine gatehold procedures	●		●	●	●
C2	Develop reduced separation procedures		●	●	●	
C3	Use dual departure tracks		●			●
C4	Implement automatic metering and spacing		●	●		
User Improvements						
D1	Reduce peak-hour demand	●			●	
D2	Improve aircraft mix		●	●	●	●