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USAir: Balancing Terminal Facilities and Runway Capacity at Pittsburgh

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This thesis was prepared under the direction of the candidate's thesis committee chairman, Mr. Rudolf Knabe, Department of Aviation Business Administration, and has been approved by the members of his thesis committee. It was submitted to the School of Graduate Studies and Research and was accepted in partial fulfillment of the requirements for the degree of Master of Business Administration in Aviation.

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Abstract

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As a result of expansion and acquisition, USAir has experienced major growth in flight operations. In an effort to accommodate this expansion, a major construction project, called the Midfield Terminal project, is underway at USAir's major hub, Greater Pittsburgh International Airport (PIT). The Midfield Terminal will result in a 60 percent increase in gate capacity for USAir and lower operating costs due to its location. However, increased gates infer increased flight frequencies. PIT already operates near capacity during peak periods and runway expansion has only been discussed. This paper evaluates the conditions of USAir at PIT with regard to the lack of landing facilities and gate expansion. There will be a dire need for additional runway capacity at PIT if USAir is to take advantage of the additional gates and the cost savings associated with those gates. Suggestions are made to avoid a critical imbalance of airport facilities.

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Research Approach

Introduction

Current conditions in the airline industry are extremely fluid. As deregulation has come into effect, airlines have found themselves in a position of "feast or famine". We have seen the proliferation of acquisitions and mergers. On the down side, many airlines have also failed as a result of intense competition brought on by the Deregulation Act of 1978.

The nation's major airlines have experienced an increase in the total number of daily flights. There has also been a tendency for airlines to utilize the "hub and spoke" traffic system. Consequently, the majority of the major airline's flights travel through hub cities. This has had a direct impact on the operating conditions at these hub airports. It has also affected the operating factors of the tenant airlines at those hubs.

USAir is based in Washington, DC and has been a leader in the air travel industry since deregulation. It has consistently increased its market position to the point where it now operates more flights per day than any other airline. The acquisition of Piedmont Airlines on August 5, 1989, is a strong indicator of future growth potential.

USAir operates several large hubs. Pittsburgh serves as the anchor of this system. The coordination and scheduling of USAir flights to and from Greater Pittsburgh International Airport (PIT), will have a substantial

impact on the effectiveness and profitability of its future operations. Maximum efforts must be made to assure adequate runway capacity exists to handle USAir demand, as well as all the other tenants at PIT.

Statement of the Problem

As USAir continues to grow through acquisition and market competition, attention must be paid to its ability to profit from expanded operations. A major factor in its ability to remain competitive and profitable will be the ability of its hub airports, PIT in particular, to handle increases in flight frequency.

When the new Midfield Terminal at PIT, which is currently under construction, opens in late 1992, USAir's gate space will increase by over 60 percent. For USAir's investment in PIT to be worthwhile, immediate use must be made of these gates. Unfortunately, there may not be adequate runway capacity to handle any substantial increases in operations over the current rate. Runway capacity is measured by the the stated number of operations a given runway combination can accommodate according to the regulations set forth by the Federal Aviation Administration (FAA). These runway capacities may limit the use of Midfield Terminal, resulting in grave consequences for USAir operations, both at PIT and system wide.

Review of Related Literature

Air travel is increasing at a fierce pace. The total volume of traffic is expected to double by the year 2000. To compound the problem, there are only two new airports currently under construction in the entire world. To handle this imbalance, current airport capacity must be expanded ("And nowhere to land", 1988).

PIT was designed and built in the early 1950's. At that time there was no possible way planners could have foreseen the conditions of today's market. As the air travel business increased, so did the traffic at PIT. According to the Federal Aviation Administration's Air Traffic Activity statistics (1988), passenger enplanements at PIT were well over 8.5 million in 1988. The FAA is projecting this figure to increase to 15 million passengers in just over five years. In addition, operations at PIT now average 1,024 movements per day, far less than the 2,192 movements per day projected for 2000 ("New airports please", 1988). This is an increase of over 114 percent. These figures only take into consideration the commercial aspect of the airport which represents 89.3 percent of aircraft movements. General aviation and military movements account for 8.7 percent and 2 percent respectively (Parrish, 1988).

Just prior to the beginning of the Midfield Terminal project in 1985 PIT consisted of 53 gates of which 33 were occupied by USAir (Blazina, 1986). The initial plans for the Midfield Terminal called for an expansion to 63 modern gates. As a result of revised forecasts by the airlines, the size of Midfield Terminal had to be increased. The latest revisions call for the construction of 75 gates, of which USAir will occupy 53. The cost of this expansion has increased over and above the original price tag of $298 million. The entire expansion project is now at $567 million, and has a projected completion date of October 1992 (Grata, 1989).

According to Edwin I. Colodny, President and Chairman of the Board of USAir (1987), the new facility encompasses 900 acres and will provide USAir with a separate commuter terminal with 25 gates. The main terminal will be capable of being expanded to 100 gates if needed. The landside terminal, the airside terminal, and the commuter terminal will be easily

accessible utilizing a modern people mover system. Also, the new position of the terminal in relation to the runways and taxiways will save USAir over $10 million annually because of aircraft routing to and from the terminal. Colodny also stated that the arrangement worked out between Allegheny County, the City of Pittsburgh, and the State of Pennsylvania to provide nearly $130 million dollars, made the deal possible.

The major reason for the expansion at PIT is the incredible surge in USAir traffic, which can be traced, in part, to the growth of USAir and the merger with Piedmont Airlines on August 5, 1989. The merger with Piedmont has more than doubled the size of the USAir fleet, number of flights per day, and the number of employees (Feldman, 1988). In addition, USAir officials have explicitly stated that they plan to use its hubs as jumping-off points for additional flights to the West Coast, Florida, and the Caribbean (Payne & Power, 1989). According to USAir's 1988 Annual Report, one of USAir's major strategies for the next five years will be to expand its east-west route system through development of its existing hub structure.

In 1989, USAir was responsible for 82 percent of aircraft operations at PIT. USAir plans to board over 62 million passengers in 1990, more than any other carrier ("USAir restructuring signals shift to post merger management", 1989). USAir has indicated it plans to continue its aggressive growth strategy into the future. The current terminal layout at PIT could not accommodate any substantial increases in flight frequencies. USAir expects the Midfield Terminal to increase its capacity at PIT by 50 percent (Rolfe, 1989). This suggests an increase in operations over and above the current level when Midfield opens in 1992. Good business sense should preclude assuming financial responsibility for gates that are not needed.

USAir has devoted substantial financial resources toward the completion of the expansion project at PIT. Because of the Residual Cost Agreement USAir has with the County of Allegheny, USAir shares a portion of all operating costs associated with the running the airport. According to Blazina (June 27, 1987), USAir has agreed to pay one third of the first $42 million cost overrun, one half of the second $42 million cost overrun, and two thirds of the third cost overrun if needed. This represents a major commitment on the part of USAir, not only to the community but also to its reaffirmation of PIT as its major hub for operations in the future. This commitment is also evident in the 30 year lease USAir has signed with PIT. USAir is gambling that the airport facilities will keep pace with USAir's demand ("Lease signed for Midfield Terminal", 1988).

As the terminal is expanded to handle the incredible increase in traffic that is projected, little attention has been given to the runway capacity of the airport. There are currently four runways at PIT; three parallel east-west runways and one northwest-southeast crosswind runway. Unfortunately, there are a finite number of movements per hour these runways are capable of accommodating. These runways are operating at capacity during peak traffic times. This has not affected current operations at PIT because of a decrease in overall traffic activity and a streamlining of the USAir schedule. Once the Midfield Terminal is complete, operators at PIT expect massive increases in traffic.

Preliminary considerations are being given to a fourth parallel east-west runway and an additional northwest-southeast crosswind runway, which would bring the total number of runways to six ("Pittsburgh in the year 2000", 1989). However, these ideas are only speculative in nature. Considering the length of time involved in the planning, design, and

construction of additional runways, the capacity problem will have already reached a critically significant level by the time the new airport terminal opens in 1992. As it is, the congestion problem has already become so severe that USAir is blaming its recent poor on-time performance figures on the delay problems at PIT. The delay problems stem from the unavailability of gates to accommodate incoming flights.

USAir has positioned itself to take advantage of the geographic location of PIT with respect to its route structure. Great emphasis must be placed on the conditions at PIT to assure a successful environment for future operations throughout the company. An imbalance between these two factors will be counter productive.

Statement of Questions

As the number of gates at PIT expand in 1992 from 53 to 75, the airlines will need to maximize the use of those gates because they will bear the financial responsibility, especially USAir. One must ask if there will be an increase in operations for USAir and its competitors proportional to the increase in gate space at PIT. If there is an increase in operations, the next major issue to be addressed will be the runway capacity at PIT. Will there be adequate capacity to accommodate the increase in operations in 1992? If there is not adequate runway capacity, what will be the consequences for USAir and other airlines operating at PIT? Without adequate runway capacity, what actions must be taken to avoid this critical imbalance.

Method

Subjects

The first subject of this research is the USAir operation at PIT. For purposes of this study USAir will include the former Allegheny Airlines, the recent acquisition of Piedmont Airlines, and Pacific Southwest Airlines. USAir's parent company, USAir Group, Inc. also owns and operates many other regional commuter airlines. The inclusion of USAir commuter airlines will also be pertinent to this study, and will be referred to as USAir Express.

The second subject of this research is the runway capacity at PIT. The major areas of concern will be the flight frequency, increases in traffic, allocation of landing clearances, gate availability, and runway capacities. When referring to air traffic operations at PIT, statistics will include commercial aviation, general aviation, military aviation and special aviation such as medical flights, unless otherwise noted. All sources of air traffic must also be considered because they will contribute to the total number of aircraft movements and to the operational environment. Attention will be paid to the need to balance runway capacity with terminal area capacity.

Design

Due to the uniqueness of this study, no one style of research will properly identify current conditions and predict the future environment. Therefore, the design of this research is best classified as a combination of historical research and observational research (a version of a descriptive study).

With the ever changing conditions in the airline industry an understanding of an airline's current situation is imperative for projecting

future circumstances. When coupled with drastic changes in an associated environmental variable, such as an airport, the consequences may have an amplified impact. This is the case with USAir and its increase in gate space as a result of the Midfield Terminal at PIT. As USAir continues to grow and expand, the position and capabilities of its major hub, PIT, may be detrimental to continued growth. By closely examining this interaction, the researcher will identify elements at PIT which may hinder the success of USAir.

This study involves the evaluation of operational data relating to an ongoing business entity. Scoring and interpretation will be accomplished by comparing two sets of data. The first set of data consists of the physical limitations of the existing facility, current operating characteristics of USAir, Federal Aviation Regulations, and the budgeting constraints of both USAir and the local government. The second set of data will consist of figures projecting the future state of affairs. These figures will highlight requirements necessary to handle the projected conditions in 1992 and beyond.

Since this research is historical in nature, it may be necessary to place greater emphasis on secondary sources. Efforts will be made to limit this bias by obtaining corroborating evidence where possible to validate data. There are no variables in this research that are capable of being controlled or manipulated. All variables in this study exist and vary according to economic principles and political posturing.

Procedure

While it may be relatively easy to forecast the state of the physical environment in 1992 due to contractual agreements and long term planning,

it will be very difficult to estimate the condition of the economy, the airline industry, and the political environment. For this reason great care will be taken to utilize the most appropriate forecast as a basis for drawing conclusions.

Chapter Two will begin with a history of aviation in the Pittsburgh area. The planning and growth of PIT will be chronicled to highlight major problems planners have faced in the past. Similar mistakes may be avoided by understanding the historical significance of past situations. The birth of a midfield terminal will also be discussed, to include the reasoning and origins for a new facility. Chapter Two will also include an analysis of USAir's position at PIT, and the impact of the Deregulation Act of 1978.

Chapter Three will explain the structure of the new terminal, airport facilities, runway configurations, and several other factors that effect air operations capacity. This information will be obtained from the Allegheny Department of Aviation, public domain material, and directly from USAir officials. USAir's position with regard to these facilities will be discussed.

Chapter Four will cover all aspects that relate to the forecasting of both passenger traffic and operations growth at PIT. This information will prove crucial to supporting the basic focus of this research. Several different methods will be discussed to highlight problems with forecasting techniques. Historical errors in forecasting will also be discussed.

USAir will be contacted to obtain information relating to its plans for the hub at PIT. Background information will be collected and analyzed to explain the growth and present position of the Airline and its need for additional capacity. Projections of USAir's size will be addressed in relation to the industry. All information needed to analyze the above will be obtained from historical public records from private and company sources. Personal

interviews will also be scheduled with USAir management. The primary focus of these interviews will be to identify problems associated with the increased gates and lack of additional runway capacity. Attention will be paid to how these factors will affect the overall operations of USAir.

USAir publications will be utilized in obtaining information with regard to operating costs. This will include, but not be limited to, annual reports and 10-K financial reports. Other operating information will be secured through Federal Government publications that compile operating statistics which the airlines are required to supply. This data will be validated by other private organizations that collect similar information.

Chapter Five will cover the runway capacity calculations at PIT. Different models for calculating airport capacity will be discussed highlighting their deficiencies. Justification will be given for using the peak hour capacity model. Projections will be made concerning the level of peak hour operations at PIT, noting the method used to calculate these figures. Peak hour operations will be examined under both instrument flight rules (IFR) and visual flight rules (VFR).

Chapter Six will cover possible methods of accommodating forecasted demand. Suggestions will be made to arrive at a more timely approach to solving the imbalance of terminal facilities and runway capacity problem. Attention will be paid to the financial aspect as well as the operational deficiency that may result if no action is taken. Various formal programs to address the current circumstances will also be discussed. Attention will also be given to the possibility of airline re-regulation.

Finally, Chapter Seven will cover the conclusions and recommendations of this research. Areas where further research is needed will be highlighted. Attention will be given to the future of USAir and PIT relative to the Airline industry.

Analysis and Conclusions Anticipated

Based on the data collected, it is expected that USAir's operations will continue to increase at a constant rate. Because of the growth in the airline industry and because of USAir's position within that industry PIT will play a vital role in USAir's continued success. USAir will continue to escalate its operations at PIT because of its financial commitment to that facility and because of PIT's geographic position in relation to the route structure.

Unfortunately, it is expected that PIT will not have adequate runway capacity, as measured by FAA guidelines, to handle the increase in operations with the opening of the Midfield Terminal. This increase in operations will stem directly from the organic growth of USAir and its desire to utilize the most efficient facilities available. In addition, the Midfield Terminal will also generate additional activity for USAir's competitors. PIT can accommodate the current activity level. But that may not be the case in 1992. Also, USAir will experience a decrease in operating costs as a result of the new facility because of the aircraft routing efficiency of the terminal. Capitalizing on the terminal location will be incentive enough to use the airport. As they do so, the number of flights that USAir would like to schedule into PIT will increase. This will not be possible if the runway capacity has already been reached.

It is imperative that additional runway capacity be planned and implemented to coincide with the completion of the new Midfield Terminal project in October 1992. Without such an expansion, USAir will not be able to realize the full financial and operational benefits of the new terminal. This situation will result in a decreasing competitive position for USAir not only in Pittsburgh, but within the industry as a whole.

Chapter Two

PIT and USAir History

Greater Pittsburgh International Airport

One would have great difficulty making the argument that our society would be better off without the benefits of air transportation. As a direct result of aviation, Man has been able to explore new geographic areas, experience other cultures, and benefit from a more efficient system of commerce. Air travel can no longer be viewed as only for the rich and privileged. The average consumer has the ability to use this mode of transportation. In fact, many argue that air travel is no longer a convenience, but a necessity. As a result, great attention and effort must be exerted to comprehend the air transportation system, its direction of growth, and the elements crucial to its continued success.

The Early Years

Allegheny County moved fully into aviation in September 1931 with the construction of the Allegheny County Municipal Airport (AGC). At that time it was the nation's first airport to incorporate the use of hard surface runways. By 1937, AGC was handling 70,000 passengers annually on two airlines. They were Trans World Airlines (TWA), and Pennsylvania Central Airlines, which later merged with United ("Gateway to the world's skies," 1972).

Air travel was becoming more commonplace. Throughout the late 1930's air travel continued to increase. It became evident that AGC would not be capable of handling any substantial increase in activity under its current configuration. Several problems presented themselves, the greatest of which was its location. AGC, which still serves as a reliever for PIT, is situated in the heart of a congested residential area. But, it would be impossible to establish a buffered land area to surround the airport, or to expand in the future if needed.

In 1941, Allegheny County identified the Bell family farm as the site for airport development. It was located approximately 17 miles west of Pittsburgh in Moon Township (see Figure 1).

The new facility was designed to accommodate both civil and military aviation needs. However, Allegheny County and the Federal Government agreed that, in case of a national emergency, the airfield would be turned over to the military to use as they saw fit (Ward, 1941).

Two short months after the plans had been finalized for the new airport, the Japanese attacked Pearl Harbor, thrusting the United States into World War II. As part of our national defense, the Government saw a great need to protect the mighty industrial machine of the Pittsburgh area. Over $5 million was spent by the Federal Government on construction and grading to form runways for defense of the area ("Civil Aeronautics approves new Moon Township airport," 1944).

As the war continued, so did the post war plans for the airport. Allegheny County had made an agreement with the Federal Government to acquire all the land needed for airport development in return for assuming control and ownership of the airfield after the war was over. By then the County had spent $278,000 for land acquisition ("Civil Aeronautics approves

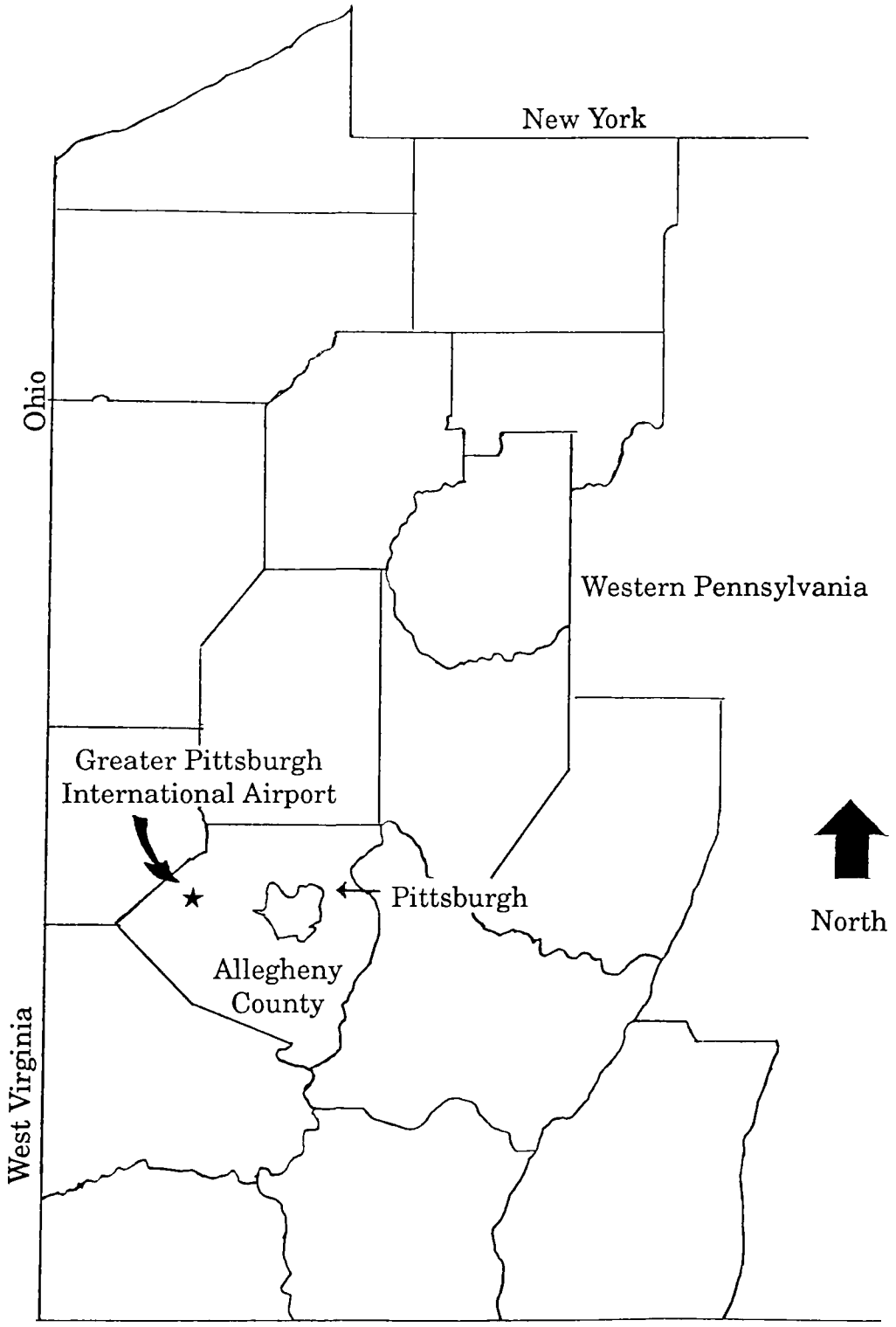

Figure 1. Airport location.

new Moon Township airport," 1944). The plans for the postwar airport had swelled to over $12 million. The new design was intended to be a flexible layout that would meet all emergencies of the future, both civil and military.

A New Era

As agreed, the facilities at PIT were turned over to Allegheny County at the conclusion of the war. The construction of the new terminal began shortly thereafter. However, the $12 million airport had erupted into a $33 million project because of expanded plans to handle consistent traffic growth. The terminal building alone cost $10 million ("Pittsburgh opens biggest inland airport," 1952).

The construction of the new airport could not have come at a better time. Traffic had grown at a steady pace ever since the opening of AGC in 1932. Figure 2 illustrates the growth in passengers at AGC, according to the Passenger Comparison from the County of Allegheny, Department of Aviation (1990). In 1951, construction of the landing facilities were coming to a close. The 1,600 acre airfield was officially opened for business on October 1, 1951.

The new terminal was a massive structure. At that time it was the largest terminal in the world (Russel, 1951). It was seven stories tall, and included many observation decks, lounges, dining rooms, a theater, and a 62 room hotel ("New $33 million airport serves Pittsburgh area," 1952). It had 16 gates which could be expanded to 32 when needed. Three runways of 8,000 feet, 6,200 feet, and 5,770 feet were operational (see Figure 3).

Soon after the opening of the airport, complaints about inadequacies began to appear. According to excerpts of editorials in American Aviation Magazine as reported in the Pittsburgh Sun-Telegraph, December 9, 1952, the planning of the airport was "short-sighted" ("Air magazine, pilot censure

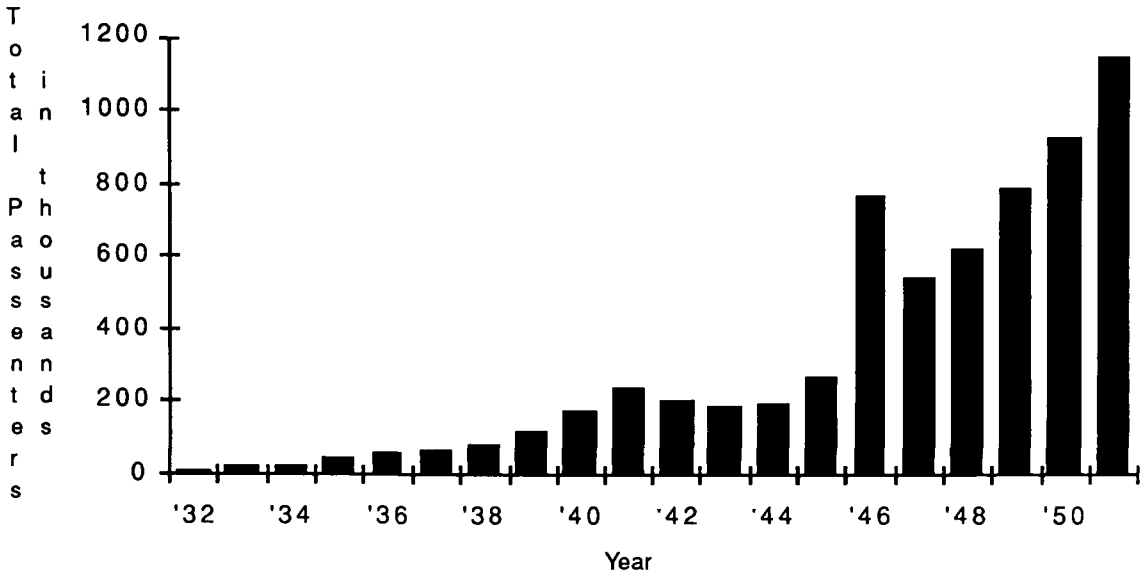

Figure 2. Historic passenger growth at AGC.

airport," 1952). Complaints about the facility ranged from "lack of runways to assure delay free travel", to "over-crowded passenger boarding areas".

By 1959, the passenger traffic at PIT was increasing at an annualized rate of 7.43 percent (Snyder, 1965). It was obvious that additional terminal capacity was needed if growth continued at its current pace. As a result, a wing was added on to the eastern side of the terminal. It is commonly referred to as the East Dock. It increased the capacity of the terminal by 62 percent, and cost $3.1 million ("Airport's $3 million wing ready," 1959).

At the same time, the County announced its plans to begin construction of a second parallel east-west runway to handle large jet aircraft (the current 28 right/10 left runway). With this additional runway, the airport capacity would increase by 60 percent. Completion was scheduled for late 1962. The runway was 10,500 feet of which 9,500 feet would be paved. The new runway was necessary because of the need for trans-continental flights. It was estimated to carry a cost of $12 million ("Airport's $3 million

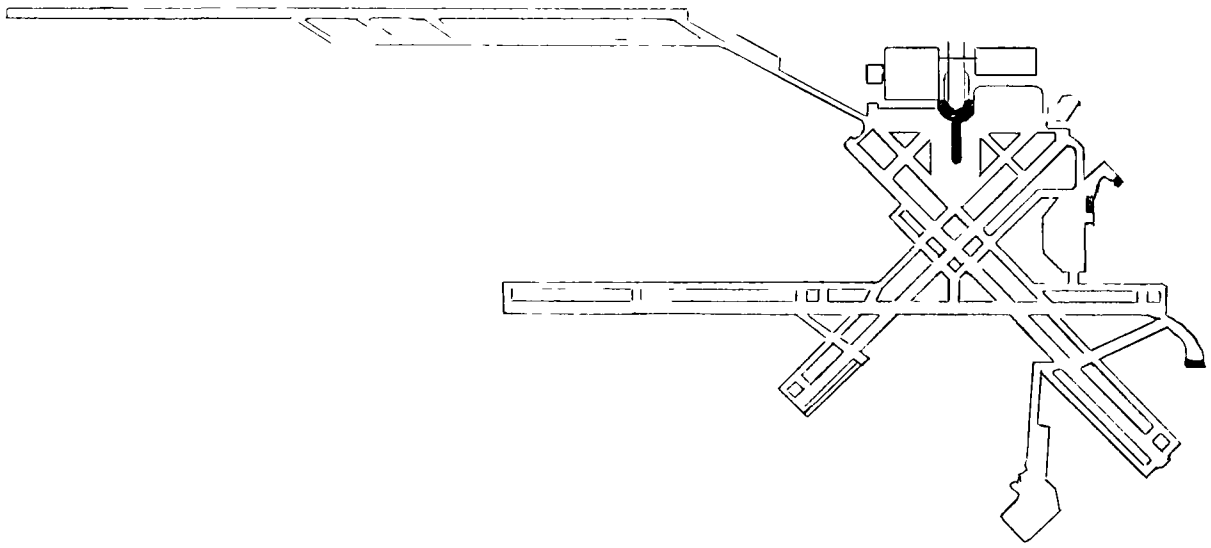

Figure 3. Initial runway layout at PIT. .

wing ready," 1959). According to the County Aviation Director in 1960, John B. Sweeney, passenger traffic had doubled since the airport opened, and will continue to rise. He placed the value of the airfield at $55 million (Christopher, 1960).

The growth of PIT continued into mid 1965. Calls for major expansion were beginning to be heard on a more frequent basis. Between the years of 1953 and 1964 revenues at PIT increased by 230 percent, passengers handled increased by 120 percent, mail hauled increased 89 percent, and freight hauled increased 19 percent (Snyder, 1965). As a result, plans were being readied for a much needed addition in the form of a new wing similar to the East Dock. The addition would be known as the West Dock, and would incorporate the airport's first use of modern jetways, which allow aircraft boarding without having to brave the weather elements. The Airport Advisory Committee estimated that passengers using the terminal would amount to at least 4 million by 1970, along with rapid growth in cargo jet operations (Snyder, 1965).

Towards the end of 1966, urgency in airport expansion was reaching critical levels. As a result, Allegheny County secured the services of the Landrum & Brown Consulting Firm to study PIT. They submitted their final report on September 23, 1966, which concluded that the terminal was outmoded and recommended the County spend between $40 to $50 million into revitalization by 1980 (Pade, 1966). They also proposed the idea of a completely new terminal located in the middle of the 3000 acre airfield. The airlines that operate at the airport were also very vocal. TWA called the airport "out of step" with needs, and "hopelessly inadequate". Temporary expansion was made in the form of FIVE new gates on the southern portion of the terminal.

As part of the Airport Master Plan, nearly $200 million was to be spent on a new cargo complex and a new terminal which would be located in the middle of the airfield. The new facilities would be capable of handling 12 million passengers by the year 2000 (Gaitens, 1967). It also called for increasing the number of gates from the current 25 to 56 by 1980. By 2000, gates were projected to number 90, with 10 to 12 million estimated passengers. Cargo capacity would be increased 500 percent by 1980, and even greater by 2000. At this point, Pittsburgh was ranked 13th in the nation in passenger traffic.

Several years passed without the County acting on the suggestions made in the latest Master Plan. But after much delay, the County took a step towards airport renovation with its approval of the purchase of 6,043 acres. This purchase brought the total airport area to 9,143 acres. This land was needed to extend the length of the existing runways, and for the construction of the third parallel east-west runway. The cost of these most recent improvements were estimated to be around $200 million (Williams, 1969).

Midfield Terminal Emerges

On April 8, 1969, Tippetts, Abbitt, McCarthy, and Stratton of New York and Richardson Gordon & Associates of Pittsburgh (consultants) submitted the first formal proposal for a six story midfield terminal at PIT ("How Midfield Terminal planning progressed," 1987). They estimated the project would cost $200 million, which was in line with the County's budget requirements.

But the County chose instead to delay the project, and opted for interim measures that were much less expensive but would also increase the

would be added to the western portion of the terminal. In addition, the South and East Docks would be extended, parking lots added, and an international building constructed ("Airport expansion set back three years," 1971). These improvements would boost the gate capacity to 39. Construction on the interim phase begin on November 1, 1970 ("Airport work to begin in November," 1970).

Consistent with the history of the airport expansion, the inability to coordinate all necessary agencies and interests in the expansion plan led to more delays and problems. By 1971, the airport expansion and new midfield terminal were going to be delayed at least another three years. By this time the project costs had risen to $250 million for the new terminal, runway and other improvements.

The ultimate objective was to establish a major international gateway through the $250 million program of airport expansion. The first step was the construction of the improvements previously mentioned. The International Building was built at a cost of $1.9 million. Upon completion of the East, West, and South Docks the gate capacity at PIT was increased from 25 to 38. The total interim project carried a price tag of $16 million and concentrated on passenger comfort and convenience ("Gateway to the worlds skies," 1972).

Up to this point in time, Runway 23/5, the southwest-northeast runway was in operation. But as a result of the new additions to the terminal, and the short length of the runway, it was phased out (Gentry, 1972). The majority of available capacity came from the operation of the dual parallel runways.

After the completion of the interim expansion, all parties involved seemed to accept the conditions at the airport. There was adequate capacity,

both in terms of runways and terminal facilities. There was no big push to initiate the permanent expansion plans beyond their current pace. For that reason, no major outcry from the public resulted when on December 12, 1976, the midfield terminal project was halted once again because of the conditions brought on by the energy crisis ("How Midfield Terminal planning progressed," 1987).

Recent Growth

As airline deregulation loomed on the horizon and the energy crisis began to subside, there was again renewed interest in the replacement of the piecemeal terminal at PIT. On November 9, 1978 the County Commissioners who control the operation of PIT, unveiled their plan to build a $250 million midfield terminal that was supposed to take the airport into the 21st century, but would take ten years to complete ("How Midfield Terminal planning progressed," 1987). On August 23, 1979, Tasso Katselas Associates were hired to complete the final designs for the terminal. One and a half years later, on March 14, 1981, Katselas revealed the first plans for the new terminal. Unfortunately, the facility had increased in cost to $300 million. As the result of another consulting firm hired to audit the Katselas plan, Peat Marwick & Mitchel Consultants, the project was pared down to $289 million and submitted for approval on September 30, 1983.

Prior to 1979, the County had decided to build another parallel runway. It was designated 28 left/10 right, and was placed into service in 1980. The need for the new runway was spawned by the emergence of Allegheny Airlines as a major player at PIT. Allegheny Airlines, which was the predecessor of the modern day giant USAir, projected significant growth. This growth stemmed directly from the benefits of the Deregulation Act of

1978. In 1978, Allegheny Airlines commanded a 40 percent share of the market in Pittsburgh, and was looking to grow even further. As a result of the increasing size of airlines, and the additional competition that resulted from deregulation, the airport was in need of additional terminal capacity. In 1980, USAir (which changed its name in October 1979) expanded the capacity of the terminal by almost 37 percent by constructing the Southeast Dock. Because of the size of the airline, and the importance of the addition, the major costs were assumed by USAir.

In 1982, the Professional Air Traffic Controllers Organization (PATCO) went on strike. Thousands of controllers lost their jobs, reducing the overall system capacity. Airlines could not profitably fly their routes because of air traffic control constraints. As a result, the airlines quickly became weary of any long term financial and operational commitments (Fotos, 1989). The Midfield Terminal was again placed on hold. The effects of the PATCO strike and the shakeout of unprofitable airlines can be seen in Figure 4 which chronicles the growth in operations at PIT since 1965.

By the mid 1980's, USAir had become the dominant carrier at PIT, which forced County officials to listen to its demand for improved facilities. As a result, Allegheny County officials began negotiations with USAir on June 13, 1986 concerning the midfield terminal. These negotiations involved the airline's contribution to the costs of the project, as well as lease fees and terms, landing fees, and a host of secondary issues. By March 1987, USAir and Allegheny County reached agreements on the major points of the negotiations. Ground breaking ceremonies were held on June 26, 1987 for the construction of what has officially come to be known as the Midfield Terminal at PIT.

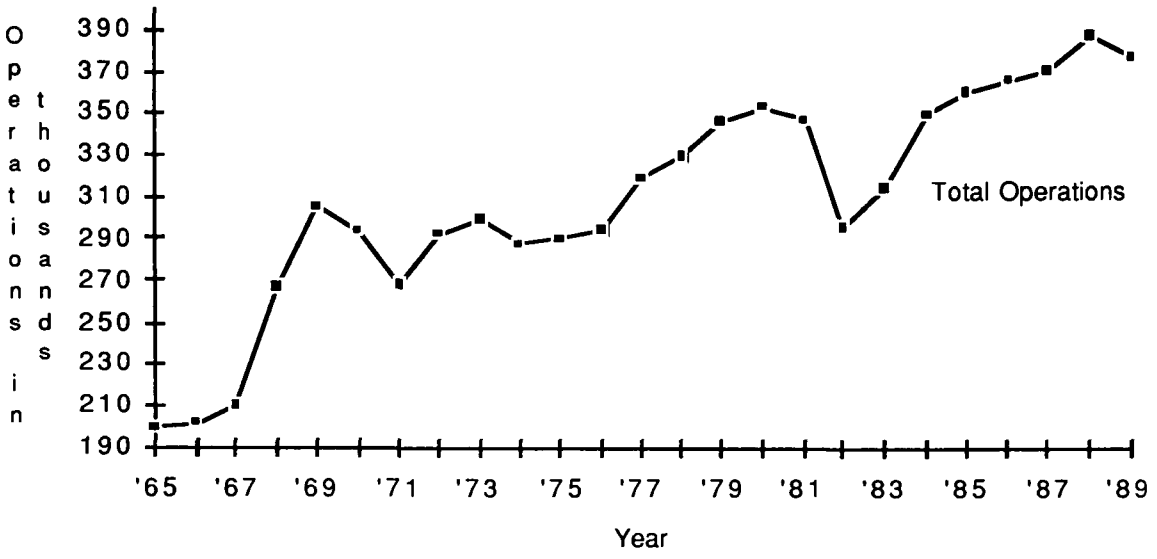

Figure 4. Historic operations growth at PIT.

But the troubles were not over for airport officials. As growth in both flight operations and passengers flowing through the terminal continued, it was recognized that the facilities could not sustain this level of activity until the Midfield Terminal was completed in 1992. According to Stephen George, Allegheny County Director of Aviation at that time, new gates would be needed by summer, 1988 (Belko, 1987). By this time, the East, West, Southern, and Southeast Docks had been extended to their limit. Passengers using the airport had increased from 15.9 million in 1986 to an estimated 17.4 million in 1987, well beyond their forecasts (Belko, 1987). The historic growth trend in passengers at PIT can be seen from Figure 5, as reported by Allegheny Department of Aviation.

Fortunately, USAir's activity at PIT decreased for two reasons. First, the demand for air travel in general flattened out in 1989. Second, according to John Bronson, director of corporate communications at PIT, USAir fine tuned its schedule in Pittsburgh following the merger with Piedmont (Vercellotti, 1990, January 27).

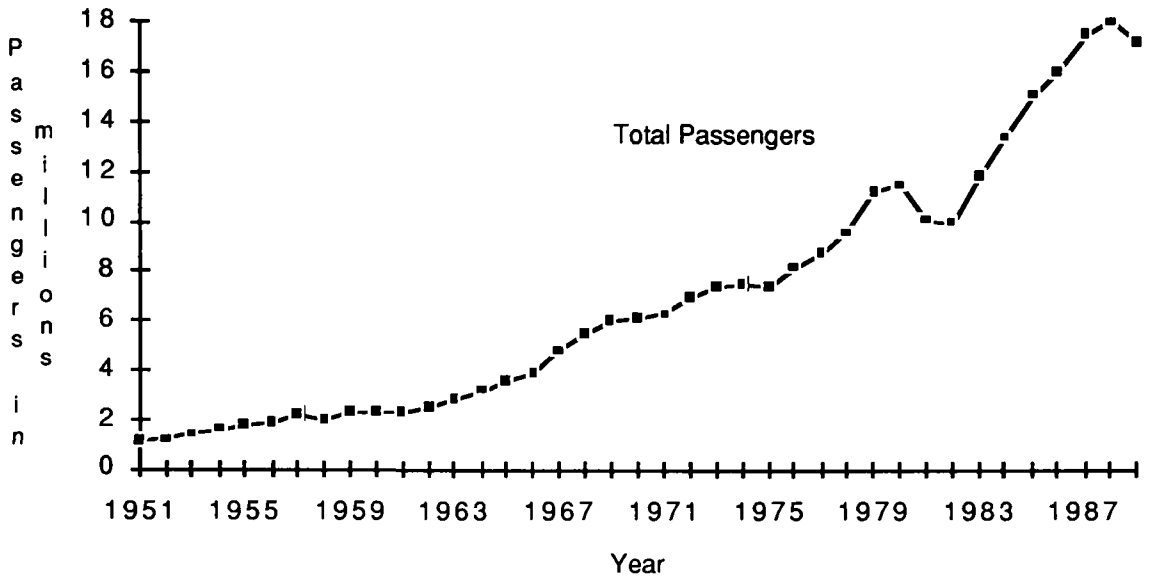

Figure 5. Historic passenger growth at PIT.

It was impossible for airport planners to foresee the explosive growth that has been experienced over the past 40 years. The major difficulty that faced PIT was the lack of flexibility in their facility planning. Fortunately, adequate land was available for expansion as demand increased. A key to success in the future will be the accurate forecast of future circumstances in terms of volume and timing. Decisions involving the airport facility will have an impact not only on the economic environment of Western Pennsylvania and those airlines that operate in that market, but will affect the entire national air transportation system and its ability to adequately handle demand.

USAir History at PIT

The origins of USAir at PIT can be traced back to the late 1940's. In 1948, the Civil Aeronautics Board (CAB) granted All American Airways (the

forerunner of USAir) the right to fly six passenger routes, the majority of which either began or ended in Pittsburgh. At that time, All American Airways main offices were located in Wilmington, Delaware.
Because of the strong regional ties to central Pennsylvania and its most prominent geographic feature, the Allegheny Mountains, All American Airways changed its name to Allegheny Airlines, Inc. effective January 1, 1953. By 1961, Allegheny Airlines' base for operations and maintenance at Washington National was too small to adequately handle its needs. Pittsburgh was chosen as the new base because of its geographic location with respect to Allegheny's route structure, as well as the facilities PIT provided (Lewis and Trimble, 1988). Adequate real estate was available to construct new structures for Allegheny's use. In addition, PIT had a relatively new terminal building which was one of the largest in the world. Further doubt about Pittsburgh being chosen as Allegheny's hub were put to rest when, in 1966, a new computerized reservation system was installed at PIT.

In 1978, Allegheny Airlines was listed on the New York Stock Exchange, and the Congress passed the Deregulation Act of 1978. Allegheny was positioned to take advantage of new market freedom. It had a strong base in the northeast and an established hub in Pittsburgh, and a lean, narrow-body fleet.

Shortly after deregulation Allegheny had become one of the nations largest air carriers. Unfortunately, it was still perceived as being a small local service airline. Allegheny could not shake this image without changing its name, which had strong regional connotations. On October 28, 1979, Allegheny Airlines changed its name to USAir. It was believed that this name would exhibit the extent of its route structure, in addition to invoking

feelings of national pride (Lewis and Trimble, 1988).

In 1982, the development of USAir was further enhanced by the completion of a building program at PIT, which included new overhaul facilities, construction of the Southeast Dock, and a new flight training facility which totaled $70 million.

On February 1, 1983, USAir Group, Inc. was formed, which is a holding company established to oversee the operation of USAir as well as many other small commuter airlines. In 1984, more than 40 percent of USAir's flights either originated or ended in Pittsburgh. In addition, USAir operated 70 percent of the total flights from Pittsburgh.

Today, USAir has grown to become the largest air carrier in the Country with respect to number of domestic passengers boarded per day. As seen in Table 1, USAir boarded 61.7 million passengers in 1988, almost 2.7 percent more than its nearest competitor, American Airlines (USAir, 1989). As of August 5, 1989, USAir operated 3,004 flights per day; USAir Express operated 1,441 per day. These flights were to 134 airports with USAir jet service and 111 with USAir Express service in 36 states. USAir's major hubs include Pittsburgh, Charlotte, and Baltimore/Washington International (see Table 2). As of August 5, 1989, USAir operated a fleet of 425 aircraft, displayed by type in Table 3. Another 115 aircraft are on firm order, with options on an additional 151, giving USAir 266 aircraft that can be delivered over the next 7 years ("USAir restructuring signals shift to post-merger management," 1989). USAir employed 24,337 people throughout its operation, and had operating income which has shown steady growth over the past ten years (see Figure 6).

Table 1

U.S. major airlines ranked by domestic passengers boarded

Air carrier	Passengers (millions)
USAir	61.7
American	60.1
Delta	57.7
United	53.3
Continental	33.6
Eastern	32.5
Northwest	31.5
TWA	21.3
Pan Am	6.8

Table 2

USAir major hub operations as of August 5, 1989

Hub	Daily jet flights	USAir Express daily flights
Pittsburgh	285	126
Philadelphia	119	134
Charlotte	300	151
Baltimore/Washington Int'l	157	98
Dayton	81	56
Syracuse	58	4

Of great interest is USAir's dominance in Pittsburgh. This is a key factor to the success of PIT and the surrounding community. For example, USAir is the area's second largest private sector employer, with 9,625 full

Table 3

USAir fleet breakdown as of August 5, 1989

Aircraft	In Service
DC-9-30	74
MD-80	31
737-200	85
737-300	99
737-400	19
767-200 ER	6
F-100	1
BAe 146	21
727-200	44
F-28 1000	20
F-28 4000	25
Total	425

Figure 6. Historic operating income for USAir.

and part-time employees. In the past five years alone, USAir has hired 3,317 new employees, almost a 53 percent increase. It currently occupies 33 jet

gates and 22 commuter gates at PIT, or 62 percent of the available gate capacity. USAir departures numbered 142,180 in 1988, or about 86 percent of all operations. In fact, of the 8.97 million passengers boarded at PIT in 1988, 7.76 million were USAir customers. These passengers were on their way to the 78 cities served by USAir from PIT ("USAir Pittsburgh Highlights," 1989). Table 4 displays important statistics on USAir's growth at PIT over the past five years.

Table 4

USAir statistics at PIT

	1984	1985	1986	1987	1988
Employees	6,308	7,028	7,666	8,424	9,625
Payroll (000)	246,000	353,000	378,000	417,000	578,000
Expenditures (000)	449,000	611,00	599,000	667,000	920,000
USAir:					
Departures	81,081	88,666	93,152	95,433	100,901
Enplanements	4,800	5,600	6,100	6,800	7,100
USAir Express:					
Departures	27,010	35,158	36,178	37,721	41,279
Enplanements	330,368	428,057	437,128	487,423	528,126

Because of USAir's position at PIT, any actions taken on its part will directly impact the environment. By the same token, most major decisions to be made by the airport officials, must include concurrent agreement by USAir. The significance of this arrangement have proved to be crucial to the success of Midfield.

Chapter Three

Developmental Status at PIT

With the beginning of construction of the Midfield Terminal in June 1987, came a host of developments that are crucial to the success of USAir as well as PIT and the surrounding community. The project is much more than a new terminal building. It represents a major commitment on the part of USAir to the Pittsburgh area, and to the entire air traffic system. It also has many economic implications that must be examined.

Midfield Terminal

The major reason for the construction of the Midfield Terminal at PIT initially was not to handle increased passenger traffic loads. In fact, Midfield was proposed over twenty years earlier, when traffic demands were only a fraction of what they are today. Granted, the plan has undergone many revisions and expansions, but the concept has endured. One of the major reasons has been the political stability of Allegheny County (Fotos, 1989). When Midfield was proposed initially, Tom Foerster was one of three County Commissioners. Mr. Foerster still serves in that capacity, and has proved instrumental in keeping the project alive.

It has only been recently that the need for the Midfield Terminal has become crucial to the success of both USAir and the continued economic development of the area. USAir has grown to limits beyond the ability of the

current terminal. If the local government wanted the valuable giant to remain in the area, accommodations would have to be made. These accommodations took the form of a new terminal to handle the increases in passenger traffic. It has been estimated by airport planners that the additional gates and more efficient configuration will allow the airport to handle 40 percent more passengers (Fotos, 1989). The major portion of those passengers are USAir passengers.

Structure

The first phase of construction involved the removal of tall earthen obstructions, followed by the concealment of numerous valleys and drainage ditches with earth. These operations involved over 18 million cubic yards of earth at a cost of $42 million, and involved 500 people working around the clock (Fraser, 1988). This was a massive undertaking in itself, and was scheduled to take two full years.

Once all site work was completed, construction of the terminal itself began towards the end of 1989. The Midfield Terminal building is expected to take about three years to complete, and has a projected completion date of October 1992. Between 30 and 50 separate contractors will be working on the project at any one time (Fraser, 1988). The project will involve over 5,000 workers at its peak, creating massive logistical problems for both the airport officials trying to maintain operations, and the airlines who may suffer financial losses from delays (Vercellotti, 1990, January 13). The construction of the Midfield Terminal is so large that over five miles of temporary roads had to be built just to accommodate the construction traffic. In fact, this project is the largest current airport development in the nation (Fotos, 1989).

As the name implies the new terminal will be located in the middle of the airfield, approximately one and a half miles west of its present site (see Figure 7). The entire project entails more than just a new terminal building. Three separate main buildings will be constructed: an airside terminal, a landside terminal, and a central services building. The total square footage of these three buildings will be in excess of 1.2 million square feet (Tasso Katselas Associates, Inc. 1986).

The initial construction plans called for an airside facility with 63 gates, and account for 58.6 percent of the total terminal square foot area. The general appearance of the terminal will be "X" shaped to accommodate the largest possible number of aircraft in the least amount of space. Initially, 200 different terminal configurations were examined. That figure was narrowed to 90, then to two, before the current design was chosen. The landside building will be located approximately 2,340 feet west of the airside building, and constitutes 32.7 percent of the total terminal square foot area. The two will be connected with an underground people mover system, which will make the journey in 63 seconds ("Facts about Greater Pittsburgh," 1990). Between the landside and airside terminal building will be a central services building, which make up the remaining 8.7 percent of the total terminal square foot area. This building will be used for a variety of purposes including commissary kitchens, maintenance rooms, police headquarters, and many other functions. But this structure will also act as the commuter terminal boarding area. In addition to the 75 jet gates, twenty-five commuter gates have been planned. These facilities were placed in this location to provide for unimpeded expansion of trunk carriers at the airside terminal when necessary. Incremental expansion of commuter airline operation will also be greatly enhanced under this configuration.

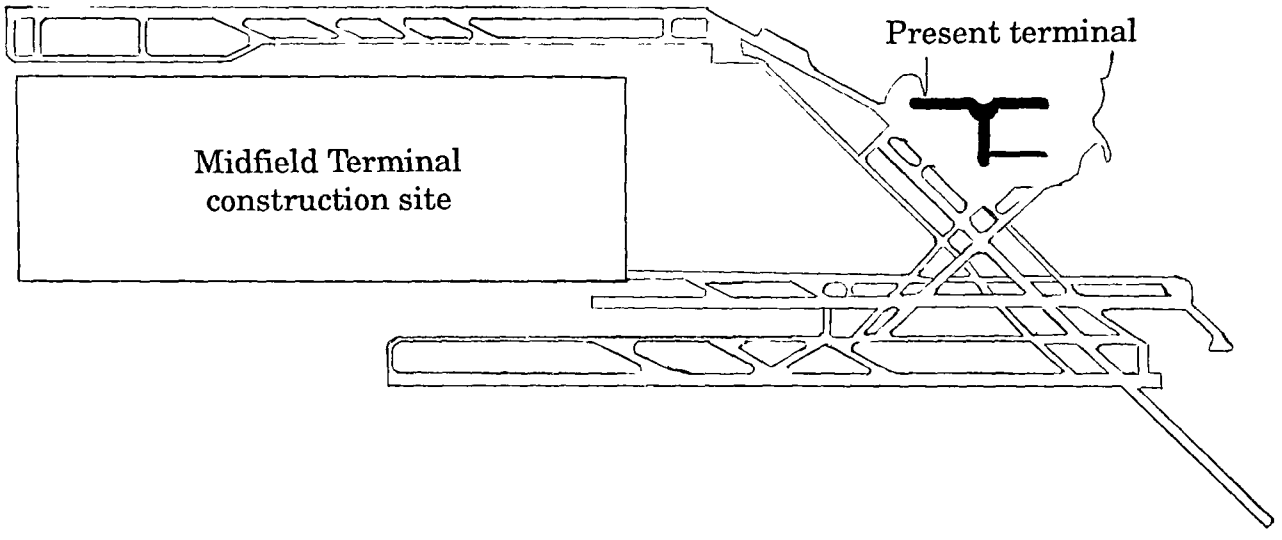

Figure 7. Midfield Terminal construction site.

The Midfield project also entails the construction of various other facilities. New accesses for both aircraft, and service and emergency vehicles must be built to assure cost effective and timely access to all airfield facilities. These include new taxiways and apron areas. Over eleven lane miles of new roads will also have to be built. In addition, over 17,000 new parking spaces will be provided for employees, rental cars, and passengers. Moving sidewalks will connect the parking facilities and the landside terminal. These sidewalks will also be placed in the arms of the "X" shaped terminal to aid passenger movements (Tasso Katselas Associates, Inc. (1986).

As a result of the turbulent history of the airport in terms of balancing capacity and demand, one would expect that officials would go to great lengths to assure that any new structures would be capable of sustaining future requirements. But only a short time into the site preparation work, it was realized that the initially planned 63 gates would be inadequate for the demand of the airlines. According to Tom Foerster, Allegheny County Commissioner, an additional 12 gates were needed to meet demand (Donavan, 1988). Traffic was increasing at a rate above that anticipated by planners. As a result the plans for the terminal had to be modified once again. The design of the new facility allows for sections of the arms to be added on with little disruption to the passengers or flight operations. After these modifications had been made to reflect the additional airline demand, the terminal construction stands at 75 jet gates. Figure 8 represents the general layout of the new Midfield Terminal. But problems may still exist. The current Director of Aviation at PIT, Scott R. O'Donnell, stated that it is conceivable that the terminal could fill all possible 100 gates by the time construction is completed, especially if another airline wanted to establish a mini-hub in Pittsburgh (Belko, 1988).

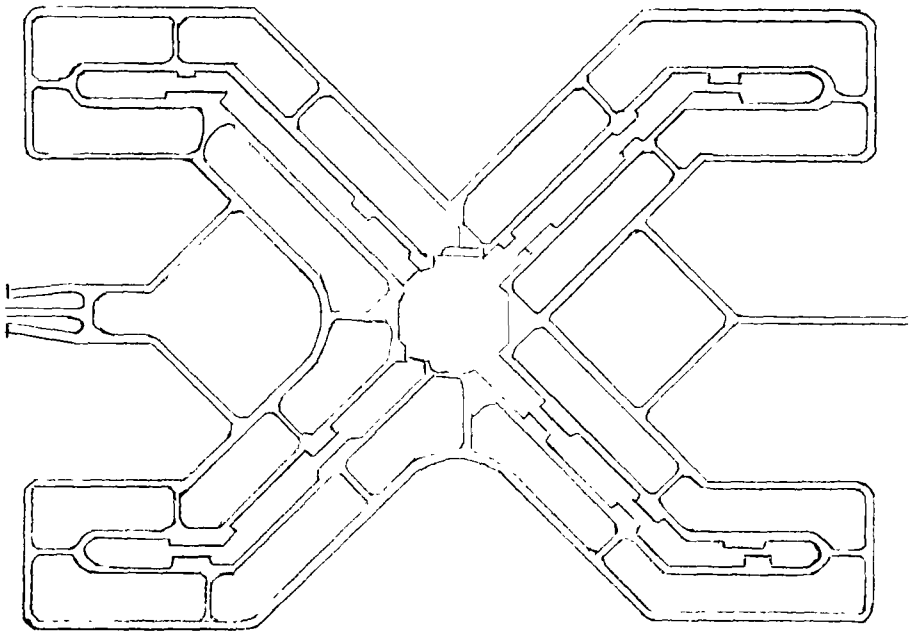

Figure 8. Midfield Terminal layout.

Because of the design of the terminal, PIT is not bound by the same set of constraints it was under with the old terminal (land and runway interference). In fact, officials are talking about the possibility of adding another "X" shaped terminal east of the one under construction, if traffic demands continue to increase. The people mover system would be extended to reach the second terminal (see Figure 9). According to USAir, it may be necessary to increase its number of gates at Midfield beyond the current 53 by an additional 10 (Belko, 1989). Since USAir is the major tenant, any expansion would be tied directly to their operational planning. Also, according to Richard Balotti, Principal planner at PIT, the second "X" shaped extension will be studied mainly to rule it out as a viable alternative (personal communication, May 16, 1990). It is more likely that any additional terminal will be placed towards the southern end of the airport property.

Financing

Initially, the Terminal was to cost $503 million (Blazina, 1987, June 10). But the estimates of the Midfield Terminal project have increased over the course of its development due to the additional gates, and because of errors in the estimation process to include inflation. The total cost of the project is now at $567 million.

One of the major keys to the success of the Midfield Terminal project has been the method in which it is being financed. A project of this size, complexity and duration called for unique financing methods. On July 29, 1987, an agreement between USAir and Allegheny County was signed which included the formula for sharing cost savings and cost overruns of the Midfield Terminal construction. The airlines will pay the first $487.5 million

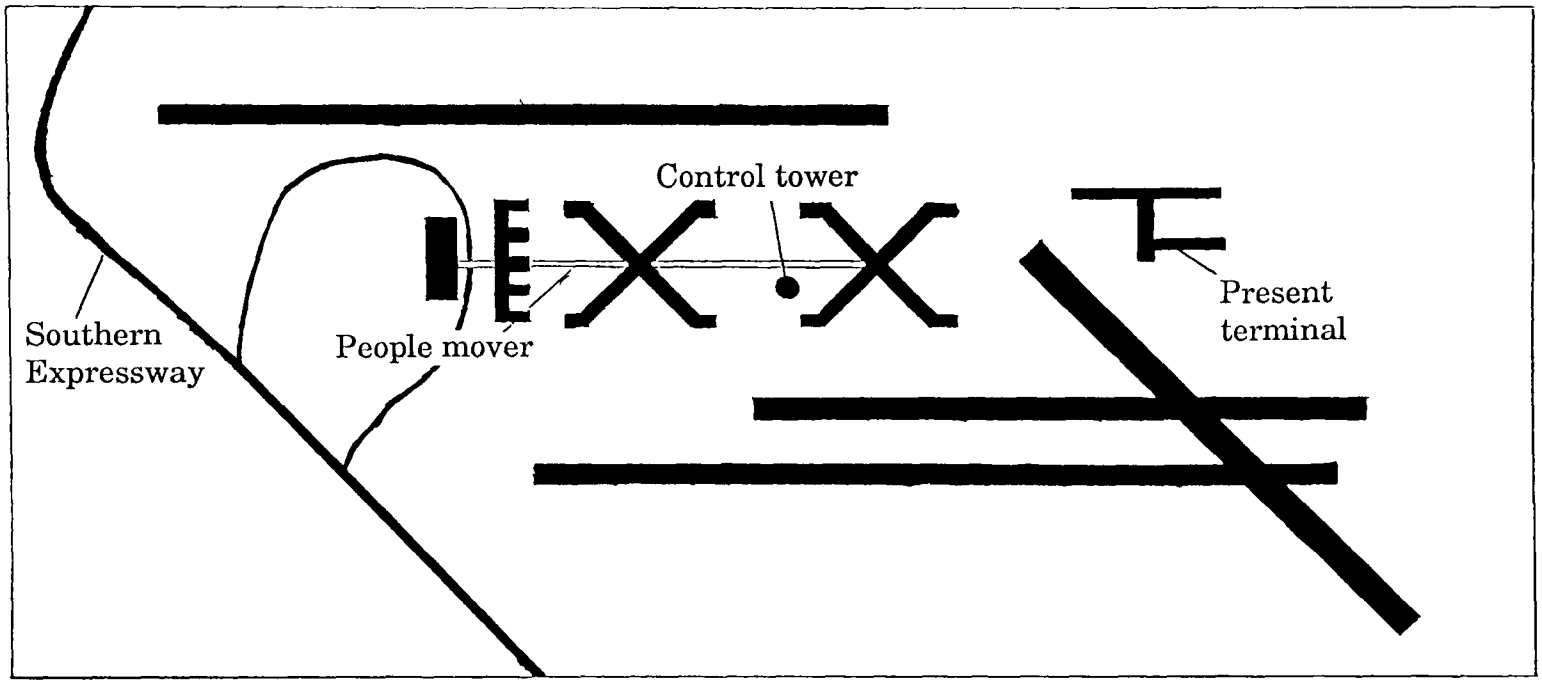

Figure 9. Possible future expansion plans at PIT.

of the terminal project through various rents and fees. These funds will be used to retire revenue bonds the County will issue to build Midfield Terminal (Linn, 1987).

Allegheny County and the Pennsylvania State Government are putting up $127.5 million; an unprecedented amount according to airport officials. According to Tom Foerster, the State of Pennsylvania contributed $85 million. The County is providing $42.5 million and the rest of the construction cost is being financed with revenue bonds. (Vercellotti, 1990, January 13). Allegheny County sold $524 million in bonds in 1 1/2 hours, with yields of between 6.9 and 8.3 percent. A major factor in the quick sale of the bonds was the signing of a 30 years lease by USAir. This effectively decreased the risk of default on the County's part. In addition, PIT was attempting to secure direct Federal aid to match the 127.5 million from State and local Governments. Success in securing these funds would be an indication that the Federal Government officials expect substantial economic benefits to result from the Midfield Terminal project. (Fotos, 1989). Unfortunately, the Federal Government only saw fit to contribute 47 percent of the $127.5 million sought, or just under $60 million (Vercellotti, 1990, January 13). Additional financial resources have been secured to allow for potential cost overruns and additions to the initial design.

Economic Impact

Area

While the development of a midfield terminal has been discussed for over twenty years, it has only recently been deemed necessary to the continued development of both the airline industry, and the local economy. It

has been estimated by the South Western Regional Planning Commission that the new terminal and economic development that coincide with it, will result in over 20,000 new jobs (Blazina, 1987, June 27). In addition, the development of the airport area will bring in an estimated $9 billion over the next 20 years (Fotos, 1989).

The construction of Midfield requires the planning and construction of an entirely new access highway because of the new location of the Terminal. This highway is commonly referred to as the Southern Expressway, and is just the first phase of a road construction program planned by the Pennsylvania Department of Transportation (PennDot). The first phase of the project carries an estimated cost of $135 million, and includes the major access road from the current highway to the Midfield Terminal. According to the Southwest Regional Planning Commission, the Southern Expressway will open 1,000 acres for commercial development and create 20,000 new jobs (Blazina, 1987, June 27).

USAir

While the construction of the Southern Expressway may be a great benefit to the community, it could prove to be a liability for USAir, at least in the short term. Construction of the Southern Expressway is projected to take 30 months, with the completion coming around March 1993, six months after the projected opening of Midfield. Originating and destination passengers (O & D) will be delayed and inconvenienced because of the construction. Without the expressway, access to Midfield will only be obtained through the use of a "back door" road with only one lane in each direction (Grata, 1990). Passengers will be required to board shuttle buses for this trip. This may cause a negative effect for USAir in goodwill. Great

efforts should be taken to assure the concurrent completion of the two projects.

Several factors will have a great impact on USAir operations as a result of the location of the Midfield Terminal. First of all, one of the greatest operating costs associated with the airlines is the fuel cost. According to the USAir's 1988 Annual Report, fuel and oil expenses amounted to $638.5 million or just over 12.1 percent of total operating expenses. Unfortunately, a large portion of that fuel was spent taxiing aircraft to terminals great distances from the runways. As a result of the efficient placement of Midfield, it has been estimated that USAir will be able to save in excess of $10 million (Colodny, 1987). According to James Frazier, Director of Operations and Facilities for USAir, the savings are not a result of shorter distances between runway and terminal, but are due to improved efficiency of movement (personal communication, May 16, 1990). Taxi distances will actually increase, but throughput efficiency is the better measure.

Second, because of the reduced taxiing times, USAir will be able to realize great savings in flight crew compensation, because block time for crew members will be reduced accordingly. Block time is the standard for which air crews are compensated, and is defined as the time the aircraft moves under its own power, until it reaches the gate at its destination. A reduction in these times can mean substantial savings over extended periods.

Third, a reduction in taxiing time will also lead to better operating efficiency and scheduling. Less time will be spent attempting to cross runways to reach the terminal. These times can be quite extensive at large airports. USAir will be able to reap the benefits of a greater on time performance, or at least minimize delays caused by airport facilities logjams. Aircraft utilization will increase resulting in improved profitability. This

situation has become a problem for USAir. Their on time performance rating has been consistently below its major competitors. For example, in February 1990 only 74.8 percent of USAir flights arrived within fifteen minutes of their scheduled arrival time (Kohnfelder, 1990). The industry average is 78 percent.

Current Operational Conditions

The airline industry is facing a critical time in its development. An inverse relationship exists between the number of air carriers and the size of those air carriers. As a result of deregulation the number of air carriers has been shrinking. The size of the remaining companies has been increasing. Some have argued that this situation has led to an inefficient market situation which approaches a monopoly simple because of the few competitors. Others believe that larger airline companies can take advantage of economies of scale to provide a better service at a decreased rate. Determining which position is accurate is not the subject of this research. But one cannot overlook certain operational characteristics of these large post deregulatory airlines. The major aspect that must be addressed is the dominance of an airport by one or two individual airlines.

PIT is the second largest airport in the country in land mass with over 12,000 square acres, second to Dallas/Fort Worth ("Facts About Greater Pittsburgh," 1990). According to the FAA Terminal Area Forecasts (TAF), (1989) PIT is currently ranked 15th in the nation in terms of passengers, and 16th with regard to operations (see Tables 5 and 6). The FAA estimated PIT to be the fastest growing airport in the country. The FAA expects PIT to grow to be the eighth busiest airport by the year 2000 with a projected 38

Table 6

US air carrier airports ranked by operations

Rank	City	State	Operations (000)	Percent
1	Chicago	IL	703,763	5.38
2	Atlanta	GA	579,898	4.43
3	Dallas	TX	492,591	3.76
4	Los Angeles	CA	416,063	3.18
5	Denver	CO	369,024	2.82
6	San Francisco	CA	329,196	2.52
7	St. Louis	MO	280,092	2.14
8	Newark	NJ	278,726	2.13
9	New York (LGA)	NY	267,412	2.04
10	Detroit	MI	267,067	2.04
11	Minneapolis	MN	265,699	2.03
12	Miami	FL	250,418	1.91
13	Boston	MA	248,048	1.90
14	Phoenix	AZ	244,309	1.87
15	Pittsburgh	PA	241,212	1.84
16	Houston	TX	223,833	1.71
17	Memphis	TN	217,145	1.66
18	Honolulu	HI	214,028	1.63
19	New York (JFK)	NY	205,954	1.57
20	Las Vegas	NV	192,610	1.47
	Cumulative percentage			60.80

Airport Layout

The FAA has designated PIT as a Terminal Control Area (TCA) Group II, which indicates that there is a moderately high level of air traffic in the area. Group II TCA's require specific equipment aboard aircraft to allow for adequate separation by air traffic controllers. PIT is one of 14 such TCA's (Federal Aviation Regulations and Airman's Information Manual, 1989).

million passengers annually ("Facts about Greater Pittsburgh," 1990). These figures alone have great impact. The conditions at the top 20 airports take on more significance when it is realized that they are responsible for almost 58 percent of all enplaned passengers and 50 percent of total operations at all domestic commercial airport facilities.

Table 5

Top 20 US air carrier airports ranked by enplaned passengers

Rank	City	State	Passengers (000)	Percent
1	Chicago	IL	27,175	6.17
2	Atlanta	GA	22,808	5.18
3	Los Angeles	CA	20,794	4.72
4	Dallas	TX	20,060	4.55
5	Denver	CO	15,786	3.58
6	New York (JFK)	NY	13,871	3.15
7	San Francisco	CA	13,678	3.11
8	Newark	NJ	11,808	2.68
9	Miami	FL	11,294	2.56
10	New York (LGA)	NY	11,237	2.55
11	Boston	MA	10,711	2.43
12	St. Louis	MO	9,811	2.23
13	Detroit	MI	9,527	2.16
14	Honolulu	HI	9,199	2.09
15	Phoenix	AZ	8,800	2.00
16	Minneapolis	MN	8,670	1.97
17	Pittsburgh	PA	8,006	1.82
18	Houston	TX	7,260	1.65
19	Orlando	FL	7,179	1.63
20	Seattle	WA	7,042	1.60
	Cumulative percentage			57.83

PIT operates with four basic runways: three of these runways are parallel to one another, and use the designator 28/10 right, left, and center. Their lengths are 11,500 feet, 10,502 feet, and 8,040 feet. The fourth runway, 22/14, is a shorter crosswind runway that cuts across two of the parallels, and is 8,101 feet (See Figure 10).

All runways are equipped with Instrument Landing Systems (ILS) for inclement weather. They are also rated for up to Category 3 operations, which have stringent aircraft equipment and pilot qualification requirements. According to the FAA controlled tower at PIT, controllers are rarely called upon to use this mode of operation. Category 2 operations constraints are in effect the majority of the time.

According to the FAA air traffic control (ATC) facility at PIT, because of the prevailing wind direction the airport operates in a westerly direction approximately 75 to 80 percent of the time. During these periods departing aircraft use runways 28 right, 28 left, and 28 center. Arrivals are accommodated on runways 32, 28 left and 28 right. During the remaining 25 to 30 percent of the time, departures occur on runways 14, 10 right, 10 center, with arrivals on runways 10 left, 10 right, and 10 center. This preferential runway assignment is due to both noise abatement procedures and efficient traffic movements.

Adjacent to PIT are several separate entities that also use the airfield facilities. They include the 911th Air Force Reserve base which operates C-130 cargo aircraft, and is located on the eastern fringe of the airport. The Pennsylvania Air National Guard (PAANG) also maintains a base on the southern fringe of the airport. The PAANG operates KC-135 Strato-tankers (Boeing 707), and the A-7 fighters. USAir operates one of its main maintenance bases at the airport. Each of these groups places an additional

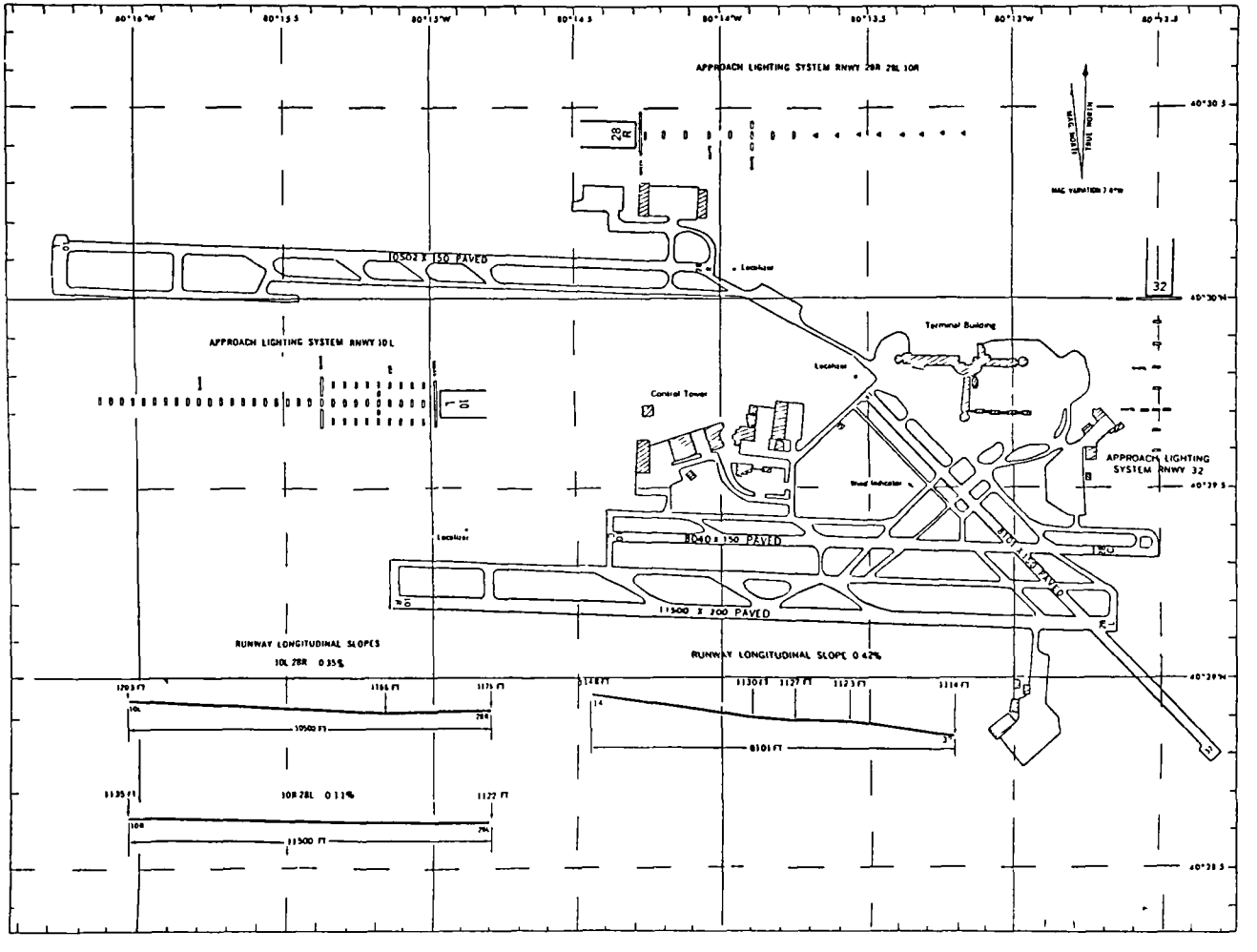

Figure 10. Current runway layout at PIT.

demand on the facilities in addition to commercial operations, and must be recognized. Generally, these operations amount to 9 percent of total operations.

In 1989, PIT had annual operations totaling 376,786 of which 344,320 were commercial operations. Of those, USAir accounted for over 296,100 operations, or over 86 percent of the operations. Approximately 60 percent of the passengers on those flights were connecting to other flights, while the remaining 40 percent were returning to Western Pennsylvania ("Facts about Greater Pittsburgh," 1990).

The majority of traffic at PIT is of a commercial nature. Approximately 91 percent of the traffic is commercial. While the name of the airport indicates "international" traffic, this is only a small portion of traffic. Consequently, most aircraft are in the "C" class, or 12,500 pounds to 300,000 pounds, as developed in the FAA's Airport Capacity and Delay Handbook (1983, AC 150/5060-5). This is the case because most international flights involve the larger aircraft such as the Boeing 747 or the Lockheed L-1011. At PIT, since USAir operates approximately 80 percent of the flights, the aircraft type breakdown will parallel USAir's fleet breakdown. For example, in 1987 almost 71 percent of all domestic commercial departures from PIT were flown on Douglas DC-9's or Boeing 737's. These same two aircraft make up nearly 65 percent of USAir's fleet. This situation will have more impact when capacity calculations are discussed in subsequent chapters because of ATC separation.

In an effort to gain complete understanding of the circumstances at PIT under the current conditions, and to accurately portray the nature of this environment in the future, the methods by which aviation forecasts are made must be examined. Accurate forecasts will not only allow for timely

and appropriate expenditures of public funds, but may be able to avoid operational deficiencies for commercial air carriers.

Chapter Four

Operations Forecasting

With the opening of Midfield Terminal in 1992, PIT will be one of the most modern facilities in the country. The terminal design will immediately improve the efficiency of passenger and aircraft movement, and will have flexibility in terms of capacity to meet future demands. The question is whether there will be an increase in demand as a result of the new terminal.

Current Terminal Utilization Projections

One of the major issues concerning the expansion of PIT will be the effect of additional gate space of Midfield Terminal on the volume of future operations. In 1988 there were 258,492 commercial air carrier operations (excludes air taxi operations) at PIT (County of Allegheny, 1989). Each of the 53 gates was responsible for accommodating 4,877 operations annually, or 13.4 operations per day. USAir was responsible for 201,802 air carrier operations. Each if its 33 gates handled 6,115 operations per year, or 16.8 per day.

The major cause for expansion in gate space at PIT is due mainly to the airline's growth, especially USAir. Therefore, it is safe to assume that these airlines have concrete plans to utilize their increased capacity at Midfield. They are financially responsible for additional gates, and would not have assumed this responsibility if they had no intention of increasing service.

If the current gate utilization is maintained PIT can expect an immediate increase in operations when Midfield opens in 1992. Total commercial air carrier operations have the potential to increase to 366,825. USAir operations may increase by as much as 61 percent to 324,996. The fact that these gates are only used during the peak operating times (7:30 AM to 9:30 PM.) underscores the problem further. For USAir, the 16.8 operations per day actually occur in a 14 hour period. These figures also indicate the limitations of Midfield Terminal (with 75 gates). When commercial operations at PIT exceed 366,825, additional terminal capacity will be needed.

The potential increase in operations according to gate utilization figures do not take into consideration growth in any other areas. Expansion into new markets, increases in air cargo activity, or the establishment of an international gateway will all cause "new" increases in operations.

Central to any suggestion of future increases in operations must be the limitations of current facilities, especially runway capacity. In addition, one must also look at whether additional capacity may be achieved utilizing an adaptation of existing facilities or procedures. If this type of approach were used, great cost savings may be realized.

The first step to answering this question is to develop an appropriate forecasting technique to adequately predict future needs. The timing of these needs will also be paramount. What is to follow is an evaluation of forecasting techniques, and their past performance. Specific areas will be highlighted which do not fall into the standard forecasting techniques. The ultimate goal will be to arrive at the most realistic forecast of traffic at PIT.

Forecasting Techniques

There are three basic methods in forecasting future operations. The first, and most common, is the time series models. Unfortunately, these models have a severe drawback in forecasting traffic demand at PIT. They all assume that future traffic activity will continue according to past performance. They do not allow for any unusual occurrences such as drastic increases or decreases due to unforeseen conditions or unusual growth. In addition, they do not react to changes in seasonal fluctuation of cyclical variation, and are slow to react to shifts in the general trend.

Causal forecasting models usually consider several other variables related to the one being predicted. Once these related variables have been found, a statistical model is built and used to forecast the variable of interest. Paramount to the success of this type of model is to find the best statistical relationship between variables. They may also include historic information. The most common quantitative causal forecasting model is regression analysis. In this method, past data of two or more variables are compared, and an equation is developed. This equation is a straight line that has the best possible "fit" in terms of the data points. This line can then be extended into future periods to forecast the variable in question. This method will become very difficult if the independent variable is just as difficult to define (ex. gross national product, unemployment rate).

And finally, judgmental forecasting models are somewhat different from those discussed thus far in that they do not involve any specific quantitative methods for arriving at a forecast. Rather, they use the experience and foresight of individuals that have extensive exposure in the area in which the forecast is being made. Greater emphasis is placed on

qualitative or subjective information. These models are especially useful when subjective factors are expected to be very important, or when accurate quantitative data is difficult to find.

Activity Forecast

While it is not the objective of this paper to develop an accurate traffic forecasting model, the success of this research does depend on determining, accurately, the level of activity at PIT in the future. In terms of predicting the volume of traffic at PIT none of the forecasting techniques discussed thus far will yield acceptable results. Therefore, a combination of these methods will be applied. They will be applied to three specific forecasts of future activity: the FAA, USAir, and PIT's planning department. This will be done to arrive at a composite estimate of future activity.

FAA Terminal Area Forecasts

As the Federal Governments arm to assure compliance with regulations and to assure safety in air travel, the FAA has the responsibility to produce forecasts of activity. This is accomplished in the FAA's TAF forecasts, which are produced annually. These forecasts are produced to show the trends in aviation, the distribution of both passengers and traffic, and to disseminate historical data. For any one airport, past information relating to operations and passengers are given, along with a projection of 15 years into the future.

The model the FAA uses is extremely complex, and takes into account a large quantity of variables, to include airport information, gross national product, forecasts of leading economic indicators, and so on. It may be

viewed as an econometric model, subject to all of the risks associated with this type of forecast. A change in any of these variables will have an impact on the accuracy of the forecast.

Historically, the TAF for PIT have shown mixed results in terms of accuracy. Figure 11 shows the FAA's forecast for operations against the actual number of operations.

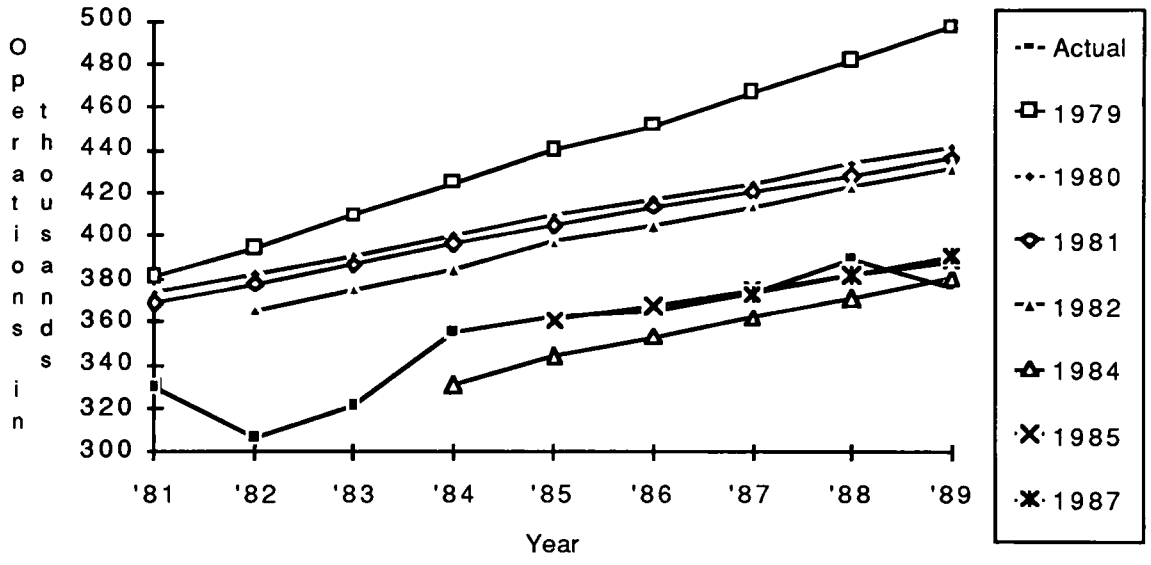

Figure 11. FAA TAF's historic performance at PIT.

Subsequent lines depict the TAF forecast for the years indicated. Forecasts for earlier periods were somewhat less than acceptable, whereas those for more recent years seem to be very good. While generalizations about the accuracy of a forecast based on several data points would be a mistake, the accuracy of years 1984, 1985, and 1987 are the best available. This can be seen further by Figure 12, which is a graphical representation of the TAF forecasts absolute error.

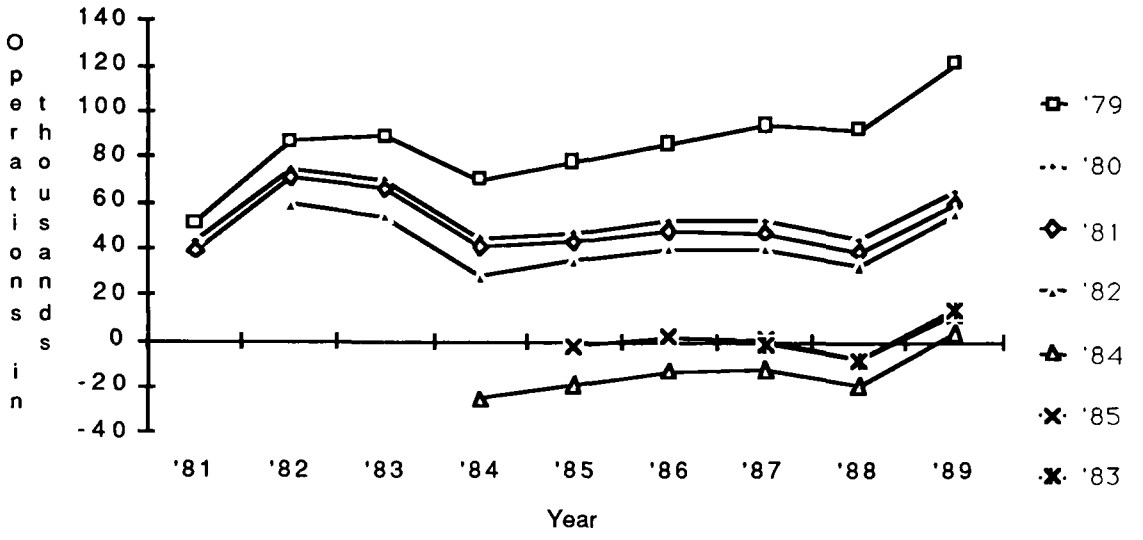

Figure 12. FAA TAF's absolute error at PIT.

On average, the FAA was in error in their forecasts by an average 24.1 percent in 1979, 15.7 percent in 1980, 14.5 percent in 1981, and 12.3 percent in 1982. However, the forecast for 1984, 1985, 1987 have proved to be much more accurate, with only a .7 percent, 1.3 percent, and 2 percent error respectively. Data from years 1983 and 1986 are unavailable. In addition, not enough information is available to assess the forecasting accuracy since 1986. Figure 13 depicts the FAA's TAF forecast of operations into 2005. The major aspect of this forecast is the tremendous jump in operations that occurs between 1992 and 1994.

USAir Activity Forecasts

The air travel industry is different from other industries in many respects. However, in terms of competitive advantage and corporate planning it is similar. For that reason, USAir was extremely guarded in providing information on their plans for PIT. Although valuable insight into the general direction of its expectations was obtained, quantitative measures

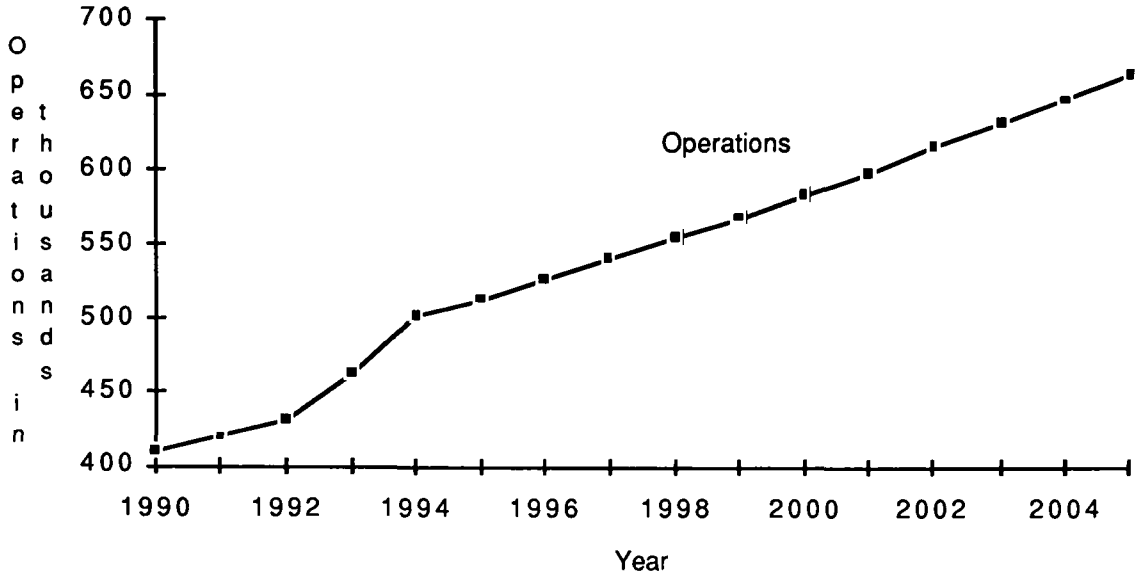

Figure 13. FAA TAF forecast of operations at PIT.

were lacking.

In an effort to obtain information concerning the operation of USAir at PIT, interviews were conducted with James Frazier, who is the Director of Operations and Services at PIT. According to Frazier, USAir has no forecast of activity that can be made public (personal communication, May 24, 1990). He did, however, indicate that because of the expansion in gates from 33 to 53 (61 percent), it would be logical to expect a substantial increase in flight activity once Midfield opens. Frazier stopped short of quantifying his statement, but speculated that the increase would be less than 61 percent. Edwin Colodny also stated that the increase in gates will permit USAir to add a significant number of new cities with nonstop service to PIT (Flanigan, 1989).

The increase in flight activity will come from strengthening the position of existing markets by increasing the flight frequency. The growth of USAir at PIT will come from several other specific areas. First, international

traffic will increase. USAir has initiated service to Frankfurt, West Germany on June 15, 1990, and has requested three additional international gates at PIT (at Midfield). Steps are being taken to initiate service to Mexico and London. Frazier stated that Canadian markets also have growth potential. Growth into these areas is not only profitable, but also because USAir is attempting to remain competitive.

The second major area which will impact activity at PIT is the level to which USAir will service its existing route structure. Because of the PSA merger, more flights are needed to service the West Coast. PIT plays a major role in servicing this area.

And finally, as a result of the hub activity, an increase in the ratio of connecting passengers and O & D passengers may shift more drastically in favor of the connecting passengers. Currently, the split is approximately 60 percent connecting, and 40 percent O & D passengers. This shift will be indicative of increased operations.

Because of the lack of any substantive forecast on USAir's part, Frazier evaluated the forecasts made by the FAA. According to the TAF, when Midfield opens, operations will jump by approximately 34,000 operations annually, or 93 a day. Nearly 80 percent of those operations, or 27,200, will be USAir operations. This works out to be approximately 75 additional operations daily, which in Frazier's words "was not unrealistic to expect". It is also important to remember that other tenants at PIT have increased their volume of gates at Midfield, which indicates that they will increase their activity as well.

The validity of the TAF forecasts cannot be taken for granted. By the same token, few alternatives exist. Frazier stated that the FAA's TAF forecasts were the best public information available regarding the forecast of

traffic activity. He also indicated that a maximum of three years data be used to make projections into the future. Data older than three years is much less reliable, and does not allow for unusual circumstances.

Many factors will affect the day to day operation of PIT in the future. Economic development, airspace capacity, passenger demand, tenant growth, and facility expansion are but a few of the items that will have a bearing on the activity level. All of these considerations will have an impact on the status of USAir activity. But USAir is not in a position to assess the overall conditions of the airfield in 1992. In addition, USAir has a vested interest in its view of the conditions at PIT. Airport officials, on the other hand, must take into consideration many other viewpoints when making decisions. These include local business, Federal and local governments, other airline tenants, and a host of other interested parties. This format improves the quality of the decision making because the outcome does not necessarily have the best interests of one party in mind. For that reason, more weight should be placed on the approach PIT officials pursue.

PIT Activity Forecasts

PIT is operated by the Allegheny County Department of Aviation, and is directly under the control of the three Allegheny County Commissioners. All major policy decisions go through the Director of Aviation, Scott O'Donnell, and ultimately to the County Commissioners Office, who must approve all major projects. The Board of Commissioners looks to the Planning Department to provide timely and accurate information concerning the airport to be used in the decision making process. Because of limited personnel and expertise, the Planning Department often uses outside consultants to conduct specific studies that relate to the operation of the

airport. These studies are provided as supplemental information, in conjunction with the Planning Department's input, to aid the Board of Commissioners in decision making. As a function of the planning process at PIT three formal forecasts have been identified that attempt to predict the level of activity in the future. Two forecasts are from third party consulting firms, and the third is a Federal Government forecast. Each will be discussed noting strengths and weaknesses.

Master Plan Forecast. As required by the FAA, PIT is in the process of updating its Master Plan. The Master Plan is the blueprint for operation for a period of ten years, and indicates the growth expected, areas in which it is expected, and the actions the airport will take to accommodate these changes. It also includes a one year capital plan and a five year capital plan. In PIT's case, work on what was supposed to be the 1990 Master Plan has fallen behind schedule. A conscious decision was made to hold off on the 1990 Master Plan because of the volume of changes taking place at Midfield. According to Richard Balotti, Project Manager, this was done because of the inability of constructing a master plan when in the process of altering so much under the 1980 Master Plan (personal communication, May 16, 1990). For that reason, the 1990 Master Plan will not be completed until late 1991 at the very earliest. PIT places great emphasis on its Master Plan to make decisions - more than most airports - especially in a period in which large growth is taking place.

Balotti stated that the first issue to be addressed in the 1990 Master Plan will be to identify the location for a fifth air carrier runway, which is supposed to be accomplished within the first six months. As a component of the Master Plan, there are eight special supplemental studies. These include

Airfield Modeling, Land Use Management, Marketing, Ground Transportation Plan, Economic Impact Analysis, and an Air Space Evaluation. These special studies are designed to address areas that will be affected as a result of Midfield Terminal project.

As mentioned before, master plans are used to budget funds, plan for capital improvement, and to plot the general direction for the airport. A majority of these type of decisions revolve around the activity expected at the airport. In PIT's case this is no different. As can be seen in Figure 14, PIT's forecasts have been fairly accurate.

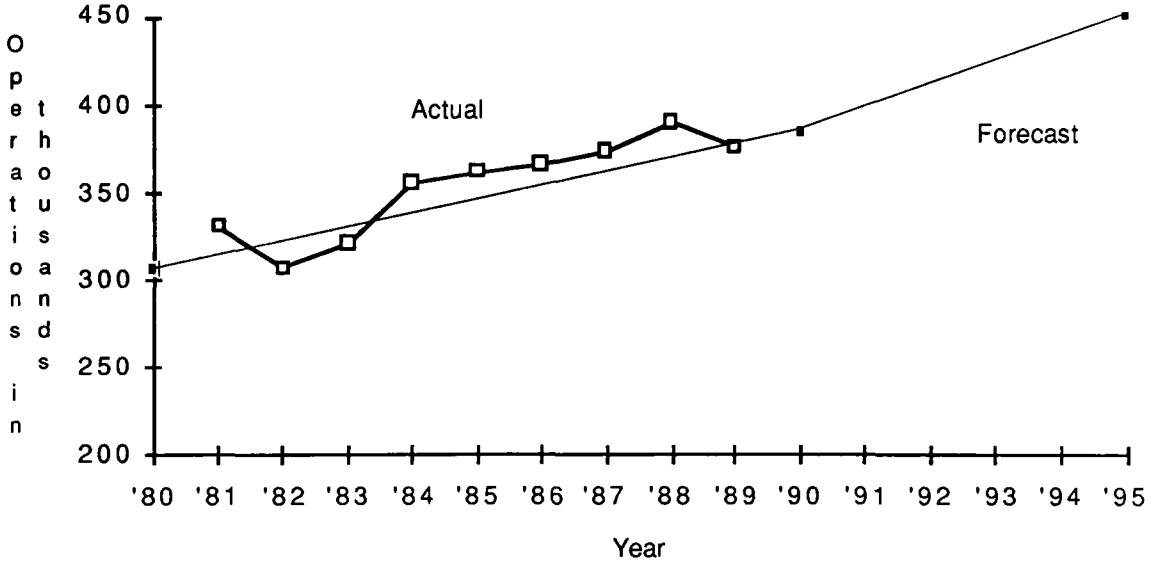

Figure 14. PIT operations forecast accuracy.

Unfortunately, as a result of the quantity and volume of changes taking place at the airport, these forecasts will be rendered useless when the Midfield Terminal opens.

Aviation Planning Associates. Because so much has changed since 1980 in terms of airport facilities and the demand to use those facilities, a different activity forecast needed to be constructed which would more adequately represent the true nature of traffic. As part of an Airfield Alternatives Evaluation study to identify alternative runway locations commissioned in 1987 by PIT, Aviation Planning Associates (AvPlan) attempted to forecast activity at the airport up to the year 2010. Figure 15 is a representation of their estimates of operations at PIT.

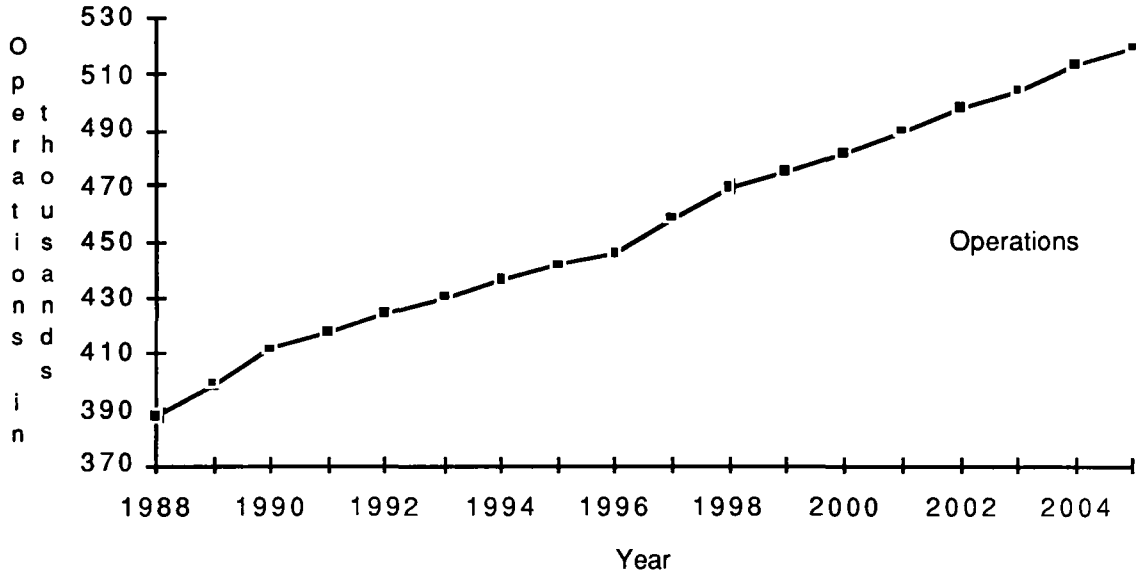

Figure 15. AvPlan operations forecast at PIT.

These figures closely parallel those produced in PIT's 1980 Master Plan. Under conditions where steady growth is expected, and only minor facility improvements are planned, this forecasts may prove to be adequate. However, PIT is in the process of undertaking a project near $.6 billion, which will drastically change the nature of the airport and the prospects for its future. The AvPlan forecast does not recognize any increase whatsoever

for additional traffic which will be generated as a result of expansion from 53 gates to 75. This fact alone renders these gates relatively useless in terms of forecasting traffic. According to the AvPlan study, PIT will grow at a rate below the national average, while Balotti stated that once Midfield Terminal opens in 1992 that will not be the case. He had no idea of the growth rate to expect in 1992, but stated that it will certainly be above the national average. In addition, the AvPlan study used only one year's worth of data to make predictions about future traffic levels. The main purpose of the study was to identify specific real estate tracts that needed to be preserved for runway expansion, and not to predict activity levels.

Peat Marwick Mitchel. PIT has one additional forecast of activity that is worth discussing. PIT commissioned Peat Marwick Main & Co., Airport Consulting Service, to perform a study entitled Update of Airline Activity Forecasts - Greater Pittsburgh International Airport, which was submitted in November 1987. This report was limited in scope, dealing only with the volume of commercial activity. It was also limited in the term of the forecast, to years 1990 and 1995. Some of the issues addressed in this report have merit, and will be mentioned.

According to Peat Marwick, there has been increased hubbing activity at three major airports: Greater Cincinnati International, Detroit Metropolitan, and Washington Dulles International. This has created increased competition for connecting traffic in the eastern United States. Connecting traffic is forecasted as being the major source of increases in enplanements at PIT. Because of this uncertainty, high and low forecasts of traffic have been devised. The low estimate takes into consideration the potentially adverse impact of additional competition for connecting

passengers from nearby hub airports. The high figure reflects the assumption that the new terminal facilities will operate at or near capacity by 1995.

As can be seen in Figure 16, these forecasts are somewhat different from those discussed thus far. Activity levels for years in between 1990 and 1995 have been interpolated based on the annual percentage given in the report.

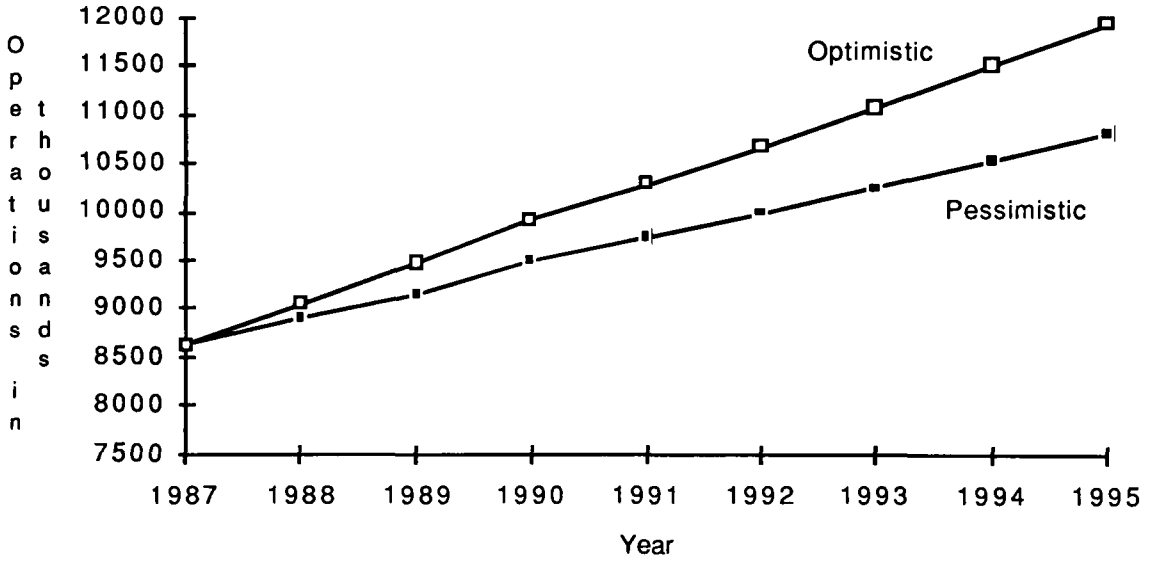

Figure 16. PMM operations forecast at PIT.

Again, the limited scope of this forecast, and its relative age, prevent its use as a basis for predicting activity levels in 1992.

Great difficulty arises when seeking information regarding the level of activity the airport expects in years to come. But, according to Richard Balotti, who is also the Principal Planner for Allegheny County, PIT will use the TAF forecasts developed by the FAA until such time as they can revise their own forecasts. Balotti estimated that they should be completed sometime within the next year (personal communication, May 16, 1990).

Research Forecasting Method Used

As a result of the unavailability of alternative forecasting figures from PIT and from USAir, and because of the relatively accurate forecasts in recent years by the FAA, the researcher will use the TAF forecasts as the indicator of future traffic levels at PIT. This approach utilizes the causal forecasting model the FAA uses, but will also recognize aspects of the judgmental forecasting model. A major factor in the decision to use the TAF forecast was its incorporation of the expansion of the terminal into their annual forecast for PIT. The TAF forecasts take into consideration a host of other variables that will have an effect on the volume of air travel, not only at PIT, but throughout the entire air transportation system.

The function of the planning department at an airport cannot be understated. The success of every project is contingent on accurately knowing the state in some future period. Using the FAA's TAF forecasts as the basis for projecting future operations, consideration can be given to predicting the actual operational conditions at PIT when Midfield opens in 1992. Concerns that directly relate to the capacity limitations of the airfield will also be scrutinized to indicate areas that require additional attention.

Chapter Five

Runway Capacity Calculations

When analyzing the capacity constraints at an airport, two separate elements must be examined. They are the capacity the facility is capable of accommodating, and the activity level that it will be required to handle. In PIT's case, there are specific limits on the actual number of operations that can be sustained in any one hour period. This is referred to as the peak hour capacity. Additional constraints on the landing capacity come in the form of weather. ATC personnel are tasked with maintaining specific aircraft separation to assure safety. As the weather conditions deteriorate, these separation requirements increase, resulting in fewer operations per hour. Good weather conditions are termed VFR, or visual flight rules, while poor weather conditions are IFR, or instrument flight rules.

According to the FAA's Airport Capacity and Delay Handbook, Advisory Circular 150/5060-5, PIT has the ability to sustain 126 VFR operations per hour, or 118 IFR operations per hour. Factors that affect this figure include the percentages and weights of aircraft using the airport (aircraft mix), runway use configuration, percentage of touch-and-go's, percentage of arrivals, airspace limitations, runway instrumentation, and taxiway layout. The intention is not to prove the FAA calculations, but to use them as a basis for estimating the ability of the current facility to handle future traffic flows. With that as the basis, attention will be focused on the capacity requirements at PIT.

Peak Operations Justifications

The manner in which the actual capacity of the airport is calculated will have a bearing on whether it is already at capacity or not. There is an extreme difference between the absolute ASV of the airport and the practical volume of the facilities. For instance, at PIT the current runway configuration is capable of handling an ASV of 1,033,680 IFR operations. With operations in 1989 at 376,786, it would appear that the runway facilities at PIT are operating at only 36 percent of capacity. But this figure assumes that the demand to land is constant throughout a 24 hour day, seven days a week, 365 days a year. It is unrealistic to expect that the demand to land at an airport will ever be distributed in such a way.

Other methods of calculating capacity may be just as unrealistic. Most airports have some sort of peak operating times throughout the course of the day, week, or month. It would be a mistake to take the airport's absolute busiest period, and construct facilities for the sole purpose of accommodating this one particular period. The remainder of the time these runways and terminals would be idle, at great cost to the taxpayers and, ultimately, to the airlines travelers themselves.

The most logical approach would entail using a combination of the absolute ASV and of peak operating times. Compromises would have to be made on the part of the airlines and those operating the airport. A solution would be to calculate runway demand based on the average activity levels on an average day, but during the busier time of the year (peak month). This would be the most appropriate method for several reasons. First, airline companies have a limited number of aircraft, which must fly to generate revenue. According to Frazier, USAir will fly its aircraft regardless of the

time of year. He said what they would do is manipulate the type of aircraft to accommodate increases in passenger activity (personal communication May 24, 1990). This, in effect, will have a tendency to balance the number of operations, at least as far as commercial airlines are concerned.

Second, if any other method of calculating runway capacity is used, potential business may be lost because of the inability of commercial entities to service their customers. Perpetual delays because of lack of runway capacity will cause decreased customer goodwill, forcing individuals to seek alternative transportation. The end result will be a decrease in the number of companies willing to do business in an atmosphere filled with delays. Airport business would decrease and growth would be curtailed, causing negative economic results for Allegheny County, surrounding communities, and the airlines.

As with most industries, the airline industry is cyclical in nature. Not only are there monthly variations in passenger and operation volumes, but there are weekly and daily pulses in the use of airport facilities. In this instance USAir and PIT are no exception. As you can see in Table 7, passenger enplanements at PIT follow a definite annual pattern. Table 7 represents the average monthly breakdown of passenger activity for a period of seven years. This information was collected from the Greater Pittsburgh International Airport Analysis of Scheduled Airline Traffic (1983 1989). Any attempt to draw conclusions based on information before this period will be ineffective because of the PATCO strike and the fallout as a result of deregulation. A seven year simple weighted average has been developed to identify the busiest times of the year for PIT.

It is necessary to recognize peak passenger demand times for several reasons. First of all, one must assure that adequate terminal facilities are

Table 7
Average 7-year historic monthly passenger distribution at PIT

	Volume	%
January	1,081,650	7.00
February	1,051,427	6.83
March	1,317,770	8.50
April	1,301,347	8.37
May	1,363,068	8.74
June	1,426,023	9.12
July	1,398,933	8.99
August	1,459,683	9.40
September	1,244,101	8.01
October	1,369,704	8.82
November	1,278,342	8.18
December	1,270,456	8.04

available to sustain rapid movement of passengers to connecting flights as well as minimizing the time spent in the terminal for O & D passengers. Second, passenger distribution will be vital in determining growth trends. These statistics should be used to assess whether the increase in passenger traffic is due to normal seasonal fluctuation or abnormal growth. This situation will be crucial to determining if additional flights should be added or cancelled.

Forecasted Runway Requirements at PIT

After having established the criteria for forecasting, and examining the circumstances in which they will be applied, attention must be focused on quantifying the actual level of activity which PIT must be capable of

accommodating. But, because of the nature of forecasting, perfect information is difficult to find. For that reason, certain assumptions and adjustments to existing data had to be made. The basis for these assumptions and adjustments will be explained.

Adjustments

Forecasted traffic at PIT will be examined according to the FAA's breakdown of operations. These include four specific categories: air carrier, air taxi/commuter, military, and general aviation (GA). According to officials at PIT, the level of GA activity will be relatively stable over the forecast period. In fact, in recent years it has declined slightly. Balotti stated that this trend is expected to continue into the future, mainly because of the increasing congestion at the airport, the increases in commercial activity, and the landing fees associated with operating at PIT. In 1983, 84 percent of all operations were of a commercial nature. By 1987 this figure had increased to almost 91 percent (FAA Terminal Area Forecast, 1989). To more accurately reflect the nature of activity, the forecast for GA activity will be adjusted to reflect static annual operations of 27,000, which was the volume in 1987. Actual figures from 1988 and 1989 have been less than 27,000, at 25,745 and 25,907 respectively. But for simplicity, 27,000 will be used to allow for the possibility of moderate growth. This will not significantly affect the FAA's forecast figures (the maximum error is less than 2 percent, which occurs in the year 2005).

Assumptions

As the result of the unavailability of perfect information, three assumptions were made regarding the distribution of operations at PIT.

They include the correlation of air taxi/commuter operations with those of air carrier, distribution of GA operations, and the distribution of military operations.

First, as a result of the nature of the hub airports, many commuter flights are utilized as feeders for the major air carriers. Consequently, this study assumes the level of commuter activity will parallel that of the commercial air traffic. This contention is backed up by the findings in the AvPlan Study.

This can further be proven by examining the historic level of air carrier operations in relation to the number of air taxi/commuter operations. A correlation coefficient (r) was used to calculate the relationship between the independent variable X, or air carrier operations, and the dependent variable Y, or air taxi/commuter operations. The formula used was as follows:

$$r = \frac{n\Sigma XY - \Sigma X\Sigma Y}{\sqrt{[n\Sigma X^2 - (\Sigma X)^2]\,[n\Sigma Y^2 - (\Sigma Y)^2]}}$$

This method yields a value of r = .83, which indicates a relatively strong positive relationship exists between the variables. A perfect positive correlation would be r = 1. For that reason, the same breakdown in percentage distribution will be used for the air taxi/commuter operations as used for the air carrier operations.

Second, an additional assumption regarding the distribution of GA activity will also be made. Because of the nature of GA activity, it is assumed that the majority of traffic will be during the summer months because of good

meteorological conditions and the traditional vacation period. Therefore, GA activity will be treated as following the same activity distribution as air carrier activity.

And finally, it will be assumed that the level of military activity will be relatively stable throughout the year. This assumption is based on past activity, predictions made by the Planning Department at Allegheny County, and the FAA TAF forecasts. This level will be approximately 7,500 operations annually, or 625 operations per month.

Peak Hour Demand/Capacity Calculations

Not only is it important to recognize what volume of traffic is expected, but it is also important to have an idea of the distribution of that traffic. This is required to assure adequate terminal facilities and runway capacity. It will also prevent the possibility of "overkill" in constructing unnecessary structures. Based on the assumptions and adjustments, an attempt can be made at identifying the peak month for operations at PIT. To this end, the 1988 and 1989 historic commercial operations were averaged. Frazier stated that USAir uses a maximum of three years of historic data to make predictions. The data from 1988 and 1989 was the most recent information available, and was most representative of the nature of operations at PIT. As can be seen in Table 8, August is the busiest month for commercial operations, followed closely by October and July.

The distribution of commercial air traffic is relatively stable throughout the year. Frazier supports this contention with his statement that USAir does not fluctuate in its level of flight activity throughout the year (personal communication, May 24, 1990).

Table 8

Monthly operations distributions at PIT

	1988		1989		Simple Average
	Volume	%	Volume	%	%
January	28,289	7.92	29,220	8.49	8.20
February	27,198	7.62	26,553	7.71	7.66
March	30,009	8.40	28,958	8.41	8.41
April	29,144	8.16	28,292	8.22	8.19
May	30,441	8.52	28,955	8.41	8.47
June	30,681	8.59	28,086	8.16	8.37
July	30,850	8.64	28,783	8.36	8.50
August	31,486	8.82	29,411	8.54	8.68
September	29,848	8.36	28,381	8.24	8.30
October	30,462	8.53	30,117	8.75	8.64
November	29,016	8.12	28,929	8.40	8.26
December	29,715	8.32	28,635	8.32	8.32
Total	357,139		344,320		

The monthly variation is within 14 percentage points. This is also supported by the findings in the AvPlan study. However, the AvPlan study identified October as the busiest month, but only looked at one year's data November 1986 to October 1987. For purposes of this study, August will be viewed as the peak month for operations.

To calculate the level of activity in number of operations, peak month percentages were used. For the air carrier and air taxi/commuter, the average peak month percentage of traffic was used, as already described (8.68 percent). For the GA category, it was assumed that the activity level will be 10 percent. This has been verified by an analysis of the Department

of Aviation's operations records. The 10 percent figure is also consistent with the AvPlan findings. Because of the small contribution of GA activity to the total number of operations, the accuracy of the 10 percent figure will not have a substantial impact on the results. Finally, as already mentioned, military activity will be viewed as being equally distributed throughout the year. This yields a 8.33 percent distribution of operations in any given month.

Consistent with the researcher's reluctance to use the peak day of the year, or peak day of peak month to calculate peak hour operations, the average day within the peak month has been chosen. Because August has been selected as the peak month, each category (air carrier, air taxi/commuter, GA, and military) will be divided by 31 (number of days in August) to arrive at the average number of daily operations within the peak month.

As the result of discussions with airport officials and the USAir Operations Division with regard to traffic activity, peak times will be viewed as occurring in the second 12 hour period of the day; that is from 12:00 Noon to 12:00 AM (PM percentage). According to Frazier, USAir has ten major arrival banks at PIT. The heaviest traffic push occurs in the evening hours, usually between 4:00 PM and 9:00 PM Bill Cannon, from the operations section of the FAA Control Tower, also supports this contention (personal communication, May 28, 1990). Calculation of peak hour operations will be based on sustaining operations during the peak PM hour.

To analyze the number of operations that occur during the peak hour, knowledge must be gained regarding the percentage of operations associated with each of the four categories. There are only 12 hours to consider when dealing with PM percentages. If traffic levels were equally distributed

throughout the 12 hour period the hourly percentage of operations would be 8.33 percent (100/12). But air traffic is not equally distributed. According to the 1988 Official Airline Guide (OAG), 9.5 percent of total commercial air carrier movements occurred during the peak hour of the average day of the peak month. Air taxi/commuter activity is more responsive to peak hour calculations. This is evident in their peak hour percentage, which is 10.7 percent. In other words, of the potential 100 percent of this category, 10.7 percent occurs during the peak hour (OAG, 1988). Because of the general stability in GA operations, the distribution of this type of traffic is relatively even throughout the day. According to FAA Control Tower Counts at PIT, the majority of GA activity occurs during a 19.5 hour period. Therefore, the percentage of GA activity during peak hour will be 5.1 percent (100/19.5). And finally, the peak hour percentage for military operations was 12.3 (FAA Control Tower Count). This increased figure can be explained by formation flying, which results in simultaneous arrivals.

The FAA TAF forecast for PIT was applied using this procedure to arrive at a forecast of total operations that can be expected during an average day of the peak month, during the peak hour. Table 9 is the peak hour analysis at PIT for the years 1990 to 2005.

Peak Hour Demand/Capacity Analysis

As can be seen, there is steady growth in the number of peak hour operations up to 1992. At that point this steady growth is replaced by a drastic increase in peak hour operations of 15.7 percent. This increase coincides with the opening of the Midfield Terminal. Because Midfield Terminal is scheduled to open in October 1992, a more accurate increase was

Table 9

Forecasted peak hour runway capacity at PIT

	1990				1991			
	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]
Air Carrier	269,000	23,349	753	72	275,000	23,870	770	73
AT/Commuter	106,000	9,201	297	32	109,000	9,461	305	33
GA	27,000	2,700	87	4	27,000	2,700	87	4
Military	7,000	583	19	2	7,000	583	19	2
Total:	409,000	35,833	1,156	110	418,000	36,614	1,181	112

	1992				1993			
	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]
Air Carrier	281,000	24,391	787	75	309,000	26,821	865	82
AT/Commuter	113,000	9,808	316	34	117,000	10,156	328	35
GA	27,000	2,700	87	4	27,000	2,700	87	4
Military	7,000	583	19	2	7,000	583	19	2
Total:	428,000	37,482	1,209	115	460,000	40,260	1,299	123

	1994				1995			
	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]
Air Carrier	340,000	29,512	952	90	348,000	30,206	974	93
AT/Commuter	122,000	10,590	342	37	126,000	10,937	353	38
GA	27,000	2,700	87	4	27,000	2,700	87	4
Military	7,000	583	19	2	7,000	583	19	2
Total:	496,000	43,385	1,400	133	508,000	44,426	1,433	137

(table continues)

	1996				1997			
	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]
Air Carrier	356,000	30,901	997	95	364,000	31,595	1,019	98
AT/Commuter	130,000	11,284	36	39	135,000	11,718	378	40
GA	27,000	2,700	87	4	27,000	2,700	87	4
Military	7,000	583	19	2	7,000	583	19	2
Total:	520,000	45,468	1,467	140	533,000	46,596	1,503	144

	1998				1999			
	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]
Air Carrier	372,000	32,290	1,042	99	381,000	33,071	1,067	101
AT/Commuter	140,000	12,152	392	42	145,000	12,586	406	43
GA	27,000	2,700	87	4	27,000	2,700	87	4
Military	7,000	583	19	2	7,000	583	19	2
Total:	546,000	47,725	1,540	147	560,000	48,941	1,579	150

	2000				2001			
	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]
Air Carrier	390,000	33,852	1,092	104	399,000	34,633	1,117	106
AT/Commuter	150,000	13,020	420	45	156,000	13,541	437	47
GA	27,000	2,700	87	4	27,000	2,700	87	4
Military	7,000	583	19	2	7,000	583	19	2
Total:	574,000	50,155	1,618	155	589,000	51,457	1,660	159

(table continues)

	2002				2003			
	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]
Air Carrier	408,000	35,414	1,142	109	418,000	36,282	1,170	111
AT/Commuter	161,000	13,975	451	48	167,000	14,496	468	50
GA	27,000	2,70	087	4	27,000	2,700	87	4
Military	7,000	583	19	2	7,000	583	19	2
Total:	603,000	52,672	1,699	163	619,000	54,061	1,745	167

	2004				2005			
	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]	Annual Ops	Peak Mo.[a]	Pk. Mo. Av. Day[b]	Pk. Mo. Pk. Hr.[c]
Air Carrier	427,000	37,064	1,196	114	437,000	37,932	1,224	116
AT/Commuter	174,000	15,103	487	52	180,000	15,624	504	54
GA	27,000	2,700	87	4	27,000	2,700	87	4
Military	7,000	583	19	2	7,000	583	19	2
Total:	635,000	55,450	1,789	172	651,000	56,839	1,834	176

[a] Peak month percentages:

Air Carrier	8.68%
AT/Commuter	8.68%
GA	10.00%
Military	8.33%

[b] Peak month activity divided by 31 days.

[c] Peak hour percentages:

Air Carrier	9.5 %
AT/Commuter	10.7 %
GA	5.1 %
Military	12.3 %

calculated by summing the increases for 1992 and 1993 (the first full year of operation).

This increase in peak hour operations will have a tremendous impact on PIT's ability to handle expected traffic. Figure 17 depicts the level of peak hour operations in relation to what the FAA has set as the capacity of the runways.

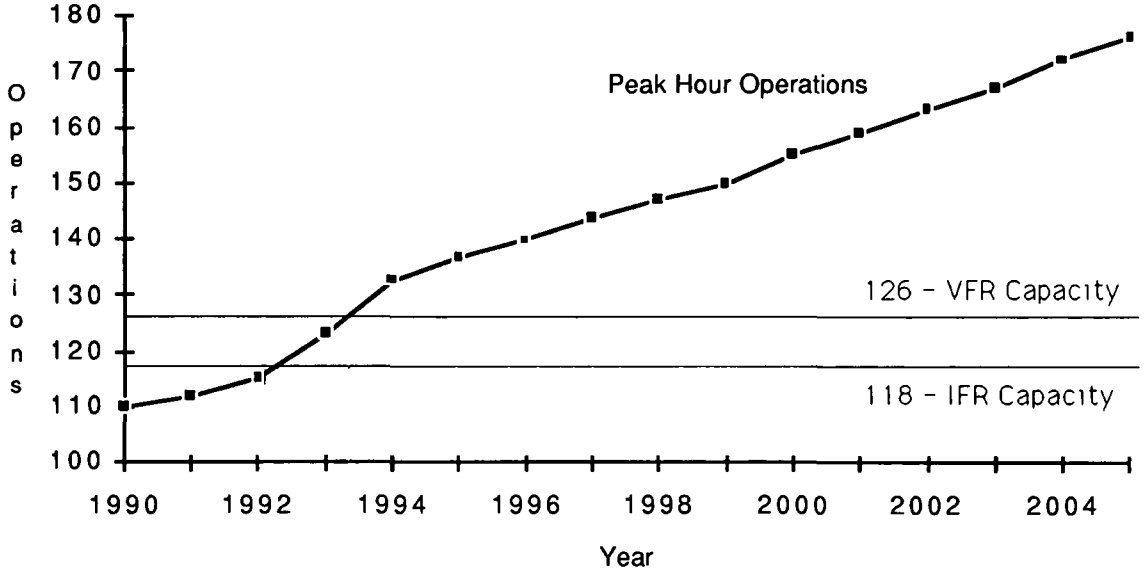

Figure 17. Peak hour demand/capacity analysis.

It is clearly obvious that the demand to land during peak operating time will exceed the facility's capacity in 1992. The situation does not get any better in years to come. Continued growth over and above PIT's capability is projected to continue into 2005.

These calculations are based on the forecast of activity at PIT utilizing the number of gates anticipated at that time. It does not allow for an expansion to more that 75 gates, which may occur in subsequent years. If this expansion occurs, the actual traffic level may increase even further.

Consistent with one of the areas in which PIT may expand (international gateway), a shift to heavy aircraft will also affect the capacity constraints by increasing the required separation. This will have a bearing on the fleet mix and ultimately on the calculations of legal capacity.

It is very important to recognize that an imbalance between airfield capacity and the demand to use those facilities may exist. But it will also be important to understand how these imbalances may affect operations at PIT. In an effort to address this issue an economic examination of the situation must be pursued.

Chapter Six

Accommodating Forecasted Demand

The national issue of major traffic growth affecting the safety of air travel is not an issue at PIT because of the ability to expand and accommodate additional traffic. However, the ability to operate safely under the current facility constraints will become an issue. It is the consensus of officials at PIT that there will be a lack of adequate runway capacity in the future. According to Balotti, the Planning Department has taken the position of support for a fifth air carrier runway (personal communication, May 16, 1990).

The dispute, however, arises when making an effort at pinpointing when this shortage will reach critical proportions. According to Balotti, the major problem in the past has been the limitations of the landside capacity. In 1992, the limitation will shift from the landside capacity to the airside capacity. Also, in 1989 USAir indicated its desire to have an additional runway built because of what it had planned. However, USAir gave no specifics. Its operational plans call for expansion at PIT, but because of their competitive position, that information is not being released.

Presently, the airport capacity exceeds airport demand. But the future growth of PIT as a major hub, and the status of the massive economic development that has sprung up around the airport are in danger. Without proper facilities to sustain operations when they are most beneficial,

commercial entities will seek alternative locations to do business. In addition, the massive investment in Midfield Terminal will have been a waste of resources. The cost for additional highways and the thousands of jobs that could be generated may be lost. In an effort to curb the possibility of this occurring, several alternatives must be examined.

Problem Recognition

As already mentioned, both airport officials and airport tenants recognize that a problem will exist in terms of runway capacity after 1992. Maintaining the status quo will be counter productive and costly. Two approaches to addressing this problem are currently under way. They are a Terminal Airspace Review and a Capacity Enhancement Task Force Study.

Terminal Airspace Review

In an effort to address the capacity issues at PIT in the future, officials have undertaken a series of studies. The overall project is entitled the Terminal Airspace Review, and involves three specific areas: airport capacity, airspace capacity, and airspace review. The issue of airport capacity is being addressed in the 1990 Master Plan.

The second leg of the study involves not only the Planning Department at PIT, but USAir and the FAA. The study is entitled The Airport Capacity Efficiency Study. USAir, jointly with Allegheny County petitioned the FAA to study the airspace conditions that will result when Midfield is open. According to Frazier, the major issue to be addressed is the configuration of the airspace that surrounds the airport (up to 30 miles). It also includes air traffic practices. The major question to be answered will be whether the

airspace above PIT has adequate capacity to handle the demand when Midfield opens.

The third leg of the study involves a review of the overlying airspace, which is governed by Cleveland Center in Ohio. The study will address the question of whether this configuration is handling traffic in the most efficient manner. Cleveland Center is in the Great Lakes Region, while PIT is in the Eastern Region.

Capacity Enhancement Task Force

PIT has initiated the second approach to solving the problem. Their study is designed to highlight areas of potential improvement in capacity, and is called the Capacity Enhancement Task Force. As part of this study, they have identified three possible ways to increase the capacity of PIT. The first method includes operational changes. Certain procedures currently used by the FAA in routing aircraft may be altered to allow for an increase in the stated number of IFR and VFR operations each runway is legally capable of sustaining. Two problems exist with this method of capacity enhancement. First, the FAA has already established criteria on the capacity of the current facilities. If these criteria are discarded, one would ask the question as to whether the safety of the system has been compromised. Second, looking back at Figure 17, an increase in the stated number of IFR and VFR runway requirements will be pushing back the inevitable. This method may "buy time", but at what cost?

The second method this task force identified were facility changes, which will be discussed, shortly. And the third method was navigational changes. These include the utilization of ATC equipment capable of providing safe control while operating with reduced separation. Examples of

such technology include Microwave Landing Systems (MLS) and a new system currently under development by the Bendix Corporation. This new technology is called a Precision Runway Monitor, and uses phased array radar to allow for simultaneous IFR approaches on close parallels of less than 2,500 feet (Stevens, 1990). It should be noted that The Capacity Enhancement Task Force study utilizes the FAA TAF forecasts as the basis for forecasting until the updated 1990 Master Plan is complete.

Static Approach

There is one additional alternative available to airport officials - do nothing. This is the most unattractive choice for several major reasons. First, this would be an incredible waste of resources currently being expanded on Midfield Terminal. Second, a cap on the volume of operations would have to be enforced. Landing and departure slots would have to be allocated on what might not be a fair basis. PIT may have to initiate bidding for these slots, similar to JFK in New York. Clearly, this scenario is highly unlikely, but may result, nevertheless.

Facility Alterations

The second area addressed by the Capacity Enhancement Task Force was the facility changes. This option warrants considerable attention. Alterations to the existing facility may add significantly to the capability of runway capacity. This is the area in which the greatest increase in capacity will be gained. Facility alterations may come in several different formats. Each will be discussed in turn.

High Speed Exits

The idea of high speed exits have received much attention lately. The sooner an aircraft exits a runway, the sooner another aircraft can land. High speed exits allow an aircraft to exit the active runway at a greater speed. This type of exit allows for as much as a 15 second savings in timed separation. While this application will increase the number of operations allowed on a given runway, it will not result in an increase capable of sustaining the volume of operation expected in the future. Constructing high speed exit will only benefit operations on runway 32/14, as all other runways already have this treatment. It should be noted that the current high speed exits on runway 28R/10L should be adjusted to accommodate the predominant western flow of traffic. Aircraft land and depart in a western direction 70 percent of the time.

Runway

The major alternative airport officials have at their disposal will be the construction of new runway facilities. This would increase the volume of peak hour operation by more than a token amount. The major decision at this point will be deciding on the location of a new runway. To this end, the AvPlan study has identified six alterative runway locations (see Table 10). For various reasons which include limited increases in peak hour operation and excessive cost, alternatives C, D, and E have been ruled out by Airport Officials. According to Balotti, the most logical location for a new runway would be alternatives A or B. He also stated that the Planning Department has a preference for a fourth parallel rather than a parallel crosswind. The most logical will be the fourth parallel.

Table 10

Available runway alternatives

Alternative	Designator	Length
A	32/14	10,000
B	27/9	8,000
C	27/9	5,000
D	27/9	10,000
E	32/14	5,000

But several factors will affect the ultimate decision on the location of the new runway. First and foremost will be the increase in peak hour operation the two main alternatives will allow. According to the AvPlan study, with the addition of a second crosswind runway PIT will have the capability to accommodate an annual service volume of 625,564, which translates to 150 VFR and 126 IFR peak hour operations. A fourth parallel runway will increase the annual service volume to 654,893 operations, and allow 157 VFR and 137 IFR operations during peak hour operations.

A second consideration to the runway location will be the cost associated with its construction. In 1987 the second parallel was estimated to carry a price tag of over $94 million, while the fourth parallel was expected to cost $77 million (AvPlan). But according to Balotti these costs would certainly have increased substantially since this study was completed. Either runway would be paid for by Federal funds collected from the purchase of every airline ticket. Justification for these expenditures must still be made.

The third consideration will be the outcome of a study that is currently underway by the FAA. Attention is being given to the possibility of allowing

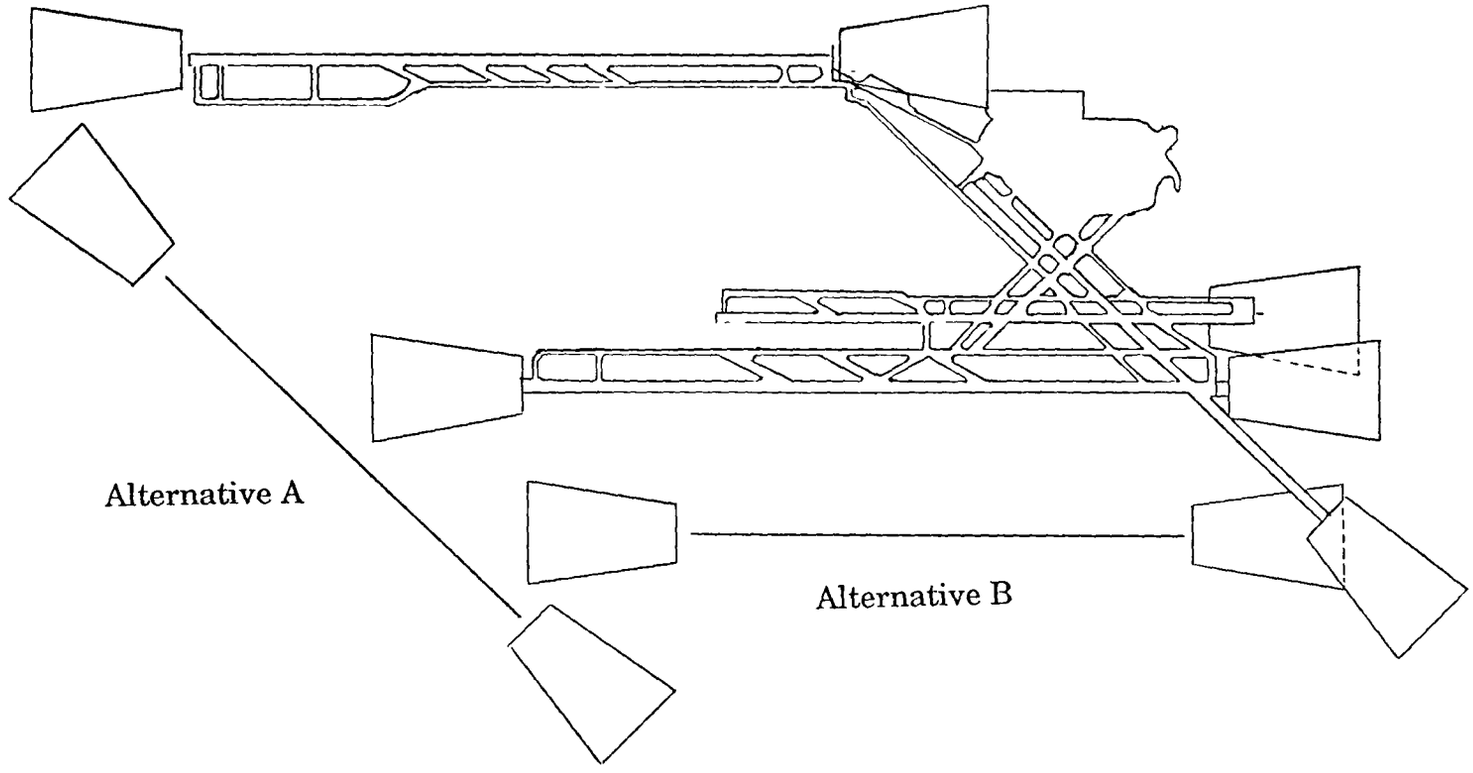

Figure 18. Alternate runway locations at PIT.

simultaneous triple parallel approaches. Balotti stated that the approval of this operational method will increase the preference for a fourth parallel even further.

Fourth, the location of a new runway will have an environmental impact in terms of noise. The east side of PIT will be most affected by noise. A fourth parallel will definitely impact developments currently under way on the east side of the airport. Airport official have not ruled out the possibility of purchasing additional real estate. According to PIT staff, noise mitigation costs would be $9,700 per household for those under 75 LDN (noise level indicator). Those households above 75 LDN would be purchased for $75,000 (these figures are subject to change). This action will be contingent on the outcome of an environmental impact study.

As already mentioned, it is the consensus of the Planning Department that a new runway will be built. The County will not wait until they have attracted additional business to the airport, mainly because of the length of time involved in the construction. Regardless of the location for this new runway, the planning process will be quite protracted. According to Balotti, once all of the environmental impact studies, engineering studies, planning, and construction are done, five years will have elapsed (personal communication, May 16, 1990).

As a result of the cost associated with planning and constructing a runway, it is highly unlikely that PIT will opt to build two runways at the same time. The Planning Department has taken the view that one additional runway will hopefully sustain the airport for the next ten years.

Operational Delay

In an atmosphere of increasing demand and limited capacity, the result will likely be increased delay times. This will result in increased costs to the airlines. Delays result when flight times are over and above scheduled operating times. The FAA criteria to calculate on-time performance defines a delay based on the airlines ability to depart within fifteen minutes of its scheduled departure time. An increase in delay time is caused by the interaction with other aircraft competing for the same facilities and/or airspace. But typically, as annual aircraft operations approach the ASV, average delay per aircraft increases very rapidly. This will be the case in 1992.

Analysis of Economic Factors

Delays for air travel can be divided into two separate categories. The first is the actual flight time between two specific points. The second is the delay that occurs between the times the aircraft lands and the time it reaches the gate. Any such delays should be of great concern to airline operators. Not only will there be an economic cost associated with the delay, but there will be sufficient loss of customer goodwill, which will affect future business opportunities. Of these two types of delays, the later of the two will be important to examine in PIT's case.

The true nature of the cost of a delay minute is difficult to quantify. But the best available method is that which is used in the FAA's Airport Capacity and Delay handbook, Advisor Circular 150/5060-5. This method takes into consideration a host of variables that include peak hour demand, runway configuration, taxiway layout, and distance which must be traveled.

At PIT there is a 52 second hold when crossing an active runway. An indicator of the severity of the delay problem can be seen by looking at an estimated average aircraft delay that can be expected in 1997 (base year chosen for comparison). If the FAA's TAF forecast are accurate the level of operations at that time will be 533,000. With no additional runway capacity, there will be an average delay of 8.28 minutes, or approximately 73,554 annual delay hours (derived from the AvPlan study). Assuming an annual inflation rate of 5.5 percent, this delay will cost the airlines approximately $108.7 million in 1997 (assumes an average operating cost of $1,478 per block hour).

Under the two main runway alternatives mentioned, there is a drastic decrease in the average aircraft delay, and in the total annual cost. With a second parallel crosswind runway, the average delay would only be 1.71 minutes, or 15,191 annual delay hours. The total cost to the airlines under this configuration will only be $22.5 million. Finally, with the fourth parallel runway, the average annual delay drops to 1.25 minutes, or 11,104 annual delay hours. The annual delay cost to the airlines will be $16.4 million.

Effects for USAir

It is possible for much to change in a seven year period. However, the position of USAir at PIT seems relatively stable. The fact that USAir has a long term lease to operate at PIT virtually assures their strong presence at PIT. PIT has emerged as USAir's main hub because it is the only airfield in the eastern United States that has the ability to grow, is efficient, has low air traffic density, and can reach any location with narrow body aircraft. For that reason, the consequences of inadequate runway capacity become more critical for its operation than any other party. But according to Frazier,

USAir does not know when the airfield will reach its capacity limit in terms of runways. He does admit that there are periods in any day where the demand for airport facilities reaches the capacity of the airfield.

The availability of runway capacity at PIT is critical to the financial success of USAir. For example, without any expansion in capacity, USAir stands to lose approximately $89.1 million because of their proportion of flight activity. Under the second crosswind alternative USAir will lose approximately $18.5 million annually. The final alternative of a fourth parallel promises a loss of $13.5 million annually to USAir.

As already mentioned, it is difficult to place a dollar figure on the true cost of an airline delay minute. According to Frazier it would be fairly accurate to take the block hour cost, and divide by 60. According to Quarterly Aircraft Operating Costs and Statistics, 3rd Quarter 1989, the average operating cost of USAir's fleet was $1,722.25 per block hour, or $28.70 per minute. The AvPlan study placed the value of a delay minute at $24.63 per minute, but averaged all air carriers.

One of the major performance statistics, which indicate the operational status of an airline, is the on-time performance record. Not only are they used as a major marketing tool, but they also highlight areas of inefficiency when they are examined on an individual airport basis. Historically, the USAir system has shown a less than enviable record for on-time performance. However, PIT has not been the cause. According to the United States Department of Transportation's Air Travel Consumer Reports (1990, March), during the first quarter of 1990, PIT's on-time performance rating was 80.1 percent. The national average is 75.3 percent. PIT has traditionally ranked at the top in terms of on-time performance. According to Frazier, PIT operates above average in terms of airport delays because of

the airfield configuration. The parallel approaches, which can operate down to category 3 weather conditions, have been credited for this success. But as traffic levels increase, delays may become an issue, not only to the operation at PIT, but system wide.

As already mentioned, the FAA is currently establishing national standards for triple approaches in low weather minimums, which will affect PIT and the location of an additional runway. According to Frazier, USAir will not back one runway location over another until the FAA completes its study. At that time USAir will support the FAA findings. One of the major concerns for USAir, when an additional runway is built, will be the capability of the airspace infrastructure, and its ability to route aircraft to the runways.

According to Frazier, USAir has three options available in case no runway is built. First, it could keep its volume of operations consistent with the capacity of the airfield. This would be the best option for the airline. Second, it could operate with the inefficiencies, which will result in delays and congestion. And third, the block times for flights operating out of PIT could be adjusted. This would be very costly and inefficient. Passengers would be reluctant to fly USAir if they would have to spend 3 hours making a flight that should have only taken two hours. The public will certainly voice its displeasure, especially if nearly $.6 billion is spent on terminal development.

The timing and accuracy of planning, not only for USAir, but for PIT will become more crucial to continued growth. Toward this end, a good working relationship between these two parties is essential. According to Frazier, USAir does not have the relationship with other airports that it has with PIT and Allegheny County. He feels the two are extremely complementary in terms of working relationship.

As a result of the massive changes in facilities at PIT, a complementary relationship will be essential. The absence of a coordinated effort between USAir and PIT officials will only result in daily operational delays, as well as long term facility deficiencies. These circumstances will prove to be counterproductive for all concerns.

Chapter Seven

Conclusions and Recommendations

General Environment

As a result of our Society's dependence on convenience, speed, and quality transportation, air travel has evolved from an alternative transportation mode to one of necessity, with no logical substitute. Business needs, emergencies, and limited vacation periods have all contributed to the popularity of air travel. Innovation and technical achievement have also contributed to activity growth with the development of aircraft capable of transporting an increased number of passengers more efficiently. In addition, the safety factor of air travel has been improved. Dependability in engine construction and the protection of redundant aircraft systems has virtually eliminated catastrophic mechanical failure. Consequently, the number and frequency of consumers utilizing air transportation has increased steadily, and will continue to do so for quite some time.

While the growth of the air transportation industry is not in itself inherently problematic, it has created circumstances that must be overcome if future growth is to continue unimpeded. The major issue that must be addressed is the capacity of the national air transportation system to service the demand for flight activity. Not only will it be important for the commercial industry, but also for the civilian and military sectors that use the same facilities.

The major barrier to unlimited growth is limited airport capacity. Several decades ago, when our current airfield facilities were being built, the upper limits of traffic volume were unknown. As a result, very little thought was given to the possibility of massive growth in this industry. Consequently, landing facilities were constructed in close proximity to major metropolitan areas. This limited the travel times from airfield to the population center. It was also the area that would provide the best possible pool of prospective customers.

As the nation continued to grow in population and prosperity, so did the major cities. As a result of the close proximity of the airports, continued growth in metropolitan areas completely engulfed the airfields. The ability to expand in the future was extremely limited, and, in some cases, completely out of the question.

There is, however, one exception to this phenomenon. PIT is the only major airfield in the eastern United States that has the ability to expand (in terms of additional runways). The airport planners should be commended for their foresight. Not only did they locate the airport away from heavily populated areas, but they also initiated a real estate purchasing program. It was a safe policy to pursue. If expansion was required, adequate land would be available; if not, the real estate would provide a buffered landing zone to protect against noise complaints.

PIT also occupies an enviable position in terms of its geographic location. Aircraft flying from PIT can reach any destination in the continental U.S. with narrow body aircraft, which operate more efficiently. Furthermore, the majority of air traffic occurs within 400 miles of PIT. Airlines operating from PIT may be able to realize increased flight densities, which will result in increased profitability.

Because of PIT's excellent position in relation to the industry, both passenger and operations forecasts call for massive increases throughout the next 15 years. The FAA predicts the volume of operations at PIT to double in the next five years alone. Whatever the reasoning behind the popularity of PIT, the basic facts remain the same; PIT's ability to expand and its geographic location in relation to the eastern half of the United States make it one of the major locations for future air traffic growth.

Operational Limitations At PIT

USAir has recognized the benefits of operating from PIT. Since the Deregulation Act of 1978, USAir has consistently increased both its size and market position. PIT has been USAir's (Allegheny's) major base for quite some time. But because of the proliferation of the hub and spoke system, as a direct result of deregulation, PIT had rapidly become USAir's major hub.

There is virtually no chance that these circumstances will change in the near term. First, USAir has signed a long term lease with the County of Allegheny, holding the airline partially responsible for the cost of current facility improvements. Second, as already mentioned, there are no other airfields in the eastern United States capable of sustaining substantial increases in flight activity. Furthermore, no additional landing facilities are under construction in the eastern half of the country. As a result, USAir activity at PIT in the future is virtually assured. Currently, USAir operations account for over 80 percent of aircraft movements at PIT. Any barriers to smooth and timely operations will have a tremendous economic impact for USAir. Two elements must be balanced if adequate and cost efficient operations are to be sustained. They are the terminal constraints

and runway constraints.

Terminal Constraint

As a result of PIT's enviable position in terms of expansion, planners must make every effort to forecast the nature of the environment in the future and assure that adequate facilities are available to handle the demand. Until now, the limitations of PIT have been blamed on the limitations of the terminal. Growth in passenger traffic has finally increased to the point were planners cannot ignore the need for additional terminal facilities. It is believed that growth in USAir operations has been the catalyst. Related to that has been the national growth of air transportation as a result of deregulation. Third, it is believed that planners finally recognized the lack of alternative landing facilities in the eastern U.S.

As a means of addressing the terminal capacity problem at PIT, the Midfield Terminal project has been initiated. One must recognize a critical reality: with the increased size and efficiency of Midfield Terminal, immediate increases in demand to use PIT will arise. The airlines would not have assumed the costs of additional gates if they had no intention of using them. In addition, the airlines will not simply redistribute their current traffic. There would be no need to increase the number of gates when the current configuration is adequate. The limiting factor of PIT will now shift from one of terminal constraints to runway limitations.

Runway Constraint

The issue of calculating an airport's runway capacity, like most issues, has at least two viewpoints. First, there are those that contend that an airport's runway capacity should be measured according to the true capacity

of the runway. In other words, a runway's limitation should be its hourly capacity, as established by the FAA, multiplied by 24 to arrive at the ASV. Utilizing this method of calculating runway capacity for planning purposes assures maximum possible use of the runways. It also assumes that true demand will be equally distributed throughout the day, month, and year.

The opposing viewpoint contends that runway capacity should be measured according to the peak operating times of that particular airport. As would be expected, the demand to use air transportation is not stable. Factors that play a key role in the level of activity include the season of the year, time of day, destination, and the type of travel. As a result, fluctuations in activity occur. Those who profess peak hour runway capacity calculations recognize these fluctuations as a basis for planning.

Each viewpoint has its benefits and drawbacks. First, planning according to ASV will be very impractical because it assumes the demand to use the runways will be equally distributed throughout a 24 hour day. If a commercial air carrier were to adjust its schedule to allow for operations at an airport using ASV criteria, its load factor would quickly drop, causing inefficient conditions. Ultimately, the airline will fail to cover its costs and cease to operate. The only possible way for this method to function efficiently would be for compulsory participation at all airports by all airlines. This would effectively eliminate any competitive advantage one airline may obtain.

The major drawback for planning according to peak hour capacity will be an inefficient use of runway capacity during off peak times. The construction costs for a modern day runway are not small. It seems rather foolish to devote massive resources to a facility that may only be used for one or two hours a day.

This study attempted to temper these two viewpoints by taking into consideration aspects of both. By using the average day in the peak month, stable and consistent traffic demand was identified. But, because of the commercial nature of air travel, peak hour operations could not be overlooked. The nature of the hub and spoke system depends on flights arriving and departing within a short period of time. This characteristic is too vital to competitive operation to compromise.

Preemptive Actions

As a result of the ever increasing need for lead time in planning and constructing modern facilities, accurate and timely forecasts of future activity should be essential. While officials at PIT have made every effort to forecast items related to the construction of Midfield Terminal, they failed to examine the effects on the runway capacity. They recognized the need to examine runway capacity, but not as an integral part of airport development. Central to any project must be its effects on related areas. In 1992, PIT will face circumstances that will certainly cause an imbalance between the demand to use terminal facilities and the capacity of the current runway configuration. There are several methods available to address this problem at PIT. If future operations growth is to continue unimpeded, immediate attention must be focused on eliminating the barrier posed by runway capacity. This can be done two ways: through additional runways or through regulatory measures for better utilization of current facilities.

Additional Capacity

The new Midfield Terminal will increase gate space by 42 percent

when it opens in late 1992. USAir on the other hand will realize an increase in its gate space by 61 percent. Inherent in these increases will be an increase in flight operations. The increase in operations is verified by the AvPlan study, Peat Marwick study, Airport Master Plan, and the FAA. While these sources disagree on the timing and volume of the increases, the consensus is that operations will increase substantially in the future.

It is the researcher's contention that these increases will occur in 1992-93. At that time the current runway configuration will be incapable of accommodating the demand. The result will be protracted delays, both on the ground and in the air. Furthermore, operational inefficiencies will result in crew compensation, fuel consumption, and loss of customer goodwill (because of delays). Because of USAir's dominance at PIT, it stands to lose the most in absolute terms from these inefficiencies. In an extremely competitive environment, such an event may cause irreparable damage to USAir.

There is only one major alternative available to avoid an imbalance between terminal facilities and runway capacity at PIT build an additional runway. Most parties concerned with the operation of PIT agree that an additional runway will be needed. Dissension arises as to when this runway should be built. USAir faces great costs in terms of operational costs and competitive position if the runway is not built. Airport officials, on the other hand, are faced with justifying additional expenditures of public funds.

The past history of the airport planning function is riddled with delay after delay. If PIT is to take advantage of its enviable position, this same approach must be avoided at all costs. Accurate and rapid decisions must be made where the new runway is concerned. The major question facing airport officials now is the location of the new runway. It is believed that the FAA

will eventually give its stamp of approval to triple parallel approaches. Because this configuration will allow the greatest increase in peak hour operations (of the runway alternatives discussed), it should be selected as the primary location. Environmental and engineering studies should be initiated immediately to avoid any further delay.

Regulatory Solution

The debate over Government involvement in private affairs sparks passionate responses. There are examples of regulation being the reason for increased costs and decreased competition. There have been just as many instances of rampant abuse and wastefulness without regulation. Where vital services are concerned, the Government has a responsibility to assure that all citizens have direct access to these services. Air transportation is one such industry.

When the Deregulation Act of 1978 went into effect, air carriers suddenly had the freedom to pick and choose their markets with little interference. Unprofitable routes were dropped and money makers were picked up. Competition brought about better service and reduced fares (although some may argue this point). But the major result of deregulation was the emergence of the hub airport, which can indirectly be blamed for the dramatic increase in operations at PIT.

In an effort to resolve the congestion of hub airports, and ultimately the problem of an imbalance of facilities and runway capacity at PIT, Government re-regulation may be a viable alternative. Although, a regression back to the circumstances of the 1970's is highly unlikely, a version of re-regulation may have merit, especially at major congested hubs. There have already been congressional hearings into just such a proposal.

Re-regulation may present itself in the form of limiting domination of a hub by a single air carrier. It may also come in the form of controlled allocation of landing slots to reduce congestion and delay. Whatever form re-regulation may take, it should be viewed as a possible solution to the congestion problems. Further study must be accomplished prior to any substantive statements as to its usefulness.

Further Research Required

As a result of the many variables involved in analyzing the circumstances at PIT, additional research into related areas must be initiated to fully understand the future. The first concern is the capability of the ATC system. Our ATC system has fallen behind the rest of the aviation industry in terms of technological advancement. Front line equipment is, in some cases, over twenty years old. The number of controllers has remained relatively static, with no plans to drastically increase their numbers. Increased workloads have placed a strain on the controllers themselves, as well as the safety factor of air travel.

Regardless of the size and capacity of the terminal, or the number and capacity of runways, the ATC system must be capable of routing aircraft to the airfield in a timely manner. Additional research must be conducted to ascertain the ATC systems ability to accomplish this task. Efforts must be made to identify what additional equipment and/or controllers will be needed to accommodate future operations at PIT.

The second area for further research involves the practicality of the hub traffic system. Ever since deregulation, the volume of air traffic has increased dramatically. Because of the freedom to enter and exit markets at

will, the airlines have adopted the hub traffic system. Further study into the benefits and drawbacks of the hub system must be initiated. Attention must be paid to issues of safety, efficiency, and operating limitations at those airports where the hub is in operation. If an alternative method of accommodating aircraft demand is found, the current expansion in terminal and runway capacity at PIT may be unnecessary.

The third area in which further study is needed revolves around the method of airport capacity calculations. The major statistics used to assess the capacity of an airfield have been the peak hour method and the ASV. These two methods lie on opposing ends of a continuum. Research must be conducted to establish an alternative method of calculating capacity; one that takes into consideration the important points of both the peak hour and ASV methods.

Fourth, there is a tendency for all major airports to utilize aviation consulting firms. Considering the volume of money involved and the impact airport facilities have on the surrounding community, it is easy to understand the need for additional information. But there may be a tendency for consulting firms to erroneously suggest expansion when it is not necessary. There is some evidence their suggestions may be self serving. Further study must be initiated to identify the consulting firms' methodology and the manner in which airport planners utilize their suggestions.

Fifth, as a result of the development at PIT, many forecasts have predicted a substantial increase in economic development near the airport. It is not known whether this increase will be tied directly to the success of PIT. If so, the absence of projected growth at PIT may have an adverse effect on the economic future of the area. Furthermore, the conditions of both PIT and USAir must be analyzed to project the impact on their respective

organizations if the growth does not materialize. What will become of the massive investment in new facilities?

The sixth area that warrants additional research concerns the forecasting method. As a result of the amount of money and time involved many organizations rely on forecasts to make decisions. The FAA is the main agency which is responsible for forecasting air traffic. Historically, these forecasts have been somewhat less than accurate. The development of more accurate forecasting techniques must be addressed.

And finally, as the volume of aircraft operations increases, various other methods to accommodate this traffic must be explored. If the growth in operations can be traced to increasing frequency on existing flights, increasing the size of the aircraft may substantially reduce the number of operations. Formal research into this possibility may reduce the chance of unnecessary expansion, and reduce overcrowded air space.

Future Outlook

The future prospects for PIT appear to be extremely bright. Not only will the airport expansion result in modern and efficient operations, but it will also serve as the basis for economic prosperity for the surrounding communities and Allegheny County. New roads to service the airport have already opened vast tracts of land for commercial development. Pittsburgh will also be able to reap the benefits through greater national attention and exposure.

USAir's future appears to be just as bright. The growth in air transportation will not reach its pinnacle for some time. USAir has a strong foundation to expand its operations and take advantage of the opportunities

directly related to the new Midfield Terminal.

The success and well being of both PIT and USAir depend on how well officials recognize and react to the obvious shortcoming in terms of runway capacity. Considering the time involved to remedy this problem, immediate attention must be given to this issue. At the very least, additional studies must be initiated to further explore future operational conditions.

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