

Issues of Importance
to U.S. Civil Aviation
and Civil Aircraft Manufacturers

***NATIONAL AIR TRANSPORT
CONGESTION AND CAPACITY PROBLEMS***

***THEIR IMPACT ON
THE AVIATION INDUSTRY***

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

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INTRODUCTION

The civil aircraft industry has been a consistent "economic winner" for the United States, contributing positive trade balances year after year. In 1988, the U.S. enjoyed an aerospace trade balance of \$17.9 billion. Over 70 percent of that surplus can be attributed to the worldwide success of U.S. civil aircraft, engines and parts.

Aside from its trade contributions, the civil aircraft industry contributes to the nation through technology spinoff and a wide range of industrial technological capability. It provides jobs for over 330,000 workers - approximately one-quarter of aerospace employment.

The commercial transport sector has been the strength of U.S. civil aircraft manufacturing in recent years. A record backlog and strong passenger growth projections indicate that will continue. Increased shipments of piston rotorcraft in 1988 and an anticipated 1989 upturn in unit sales of turbine helicopters - plus strong sales of business jets and single engine piston aircraft by general aviation manufacturers - are other promising signs for the civil sector. This positive picture helps offset the less optimistic prospect for the aerospace defense sector. Until recently, U.S. military orders provided the impetus for growth in the industry's workload; however, civil orders now drive backlog growth.

Civil aircraft industry prospects *are* good. But it would be a mistake for the United States to assume that the industry's market position is indefinitely assured. Foreign competition is strong and growing. Other countries recognize the important role aerospace plays in developing a nation's industrial and technological capabilities. Aerospace, including civil aircraft manufacture, contributes enormously to national economic well-being through technology spinoffs and a diffusion of technological capability to other industrial sectors. This awareness - combined with the pressures of financing new aircraft and engine projects and of competing for sales in a growing market that is now largely outside the United States - has fostered a global industry of many highly capable players.

Civil aviation trade issues - particularly foreign government support of manufacturers - have received considerable attention in recent years. In a number of instances, the fact that civil aircraft manufacturers abroad receive direct government support influences the United States' business position. But matters relating to U.S. policy and its implementation also have a strong influence on U.S. civil aviation and U.S. civil aircraft manufacturers.

This paper is one in a series on civil aviation issues. The series is published in an effort to look beyond present success and assure that a world-class U.S. civil aircraft industry remains on the leading edge.

NATIONAL AIR TRANSPORT CONGESTION AND CAPACITY PROBLEMS: THEIR IMPACT ON THE AVIATION INDUSTRY

SUMMARY

Constraints on U.S. airport system capacity directly affect the airlines and their customers by creating delays, limiting access at critical airports, causing community environmental problems, and creating the perception that safety margins are decreasing. The costs to the airlines of solving these problems are passed along to customers in the price of their tickets. It is unclear what the effect of these costs might be over the long term, but it could be to adversely impact the business and personal benefits of air travel through decreased air travel growth. Even if demand is not reduced, regulations that require early retirement of aircraft, reengining or engine modifications, or new onboard avionics for safer operation may be imposed on aircraft operators before they are financially able to incorporate them.

U.S. aircraft manufacturers are also affected by air system problems. It is their task to develop and apply technology in a timely, cost-effective manner to meet changing - but often uncertain - market needs. Congestion alone can restrain the now promising demand for U.S. manufactured aircraft, or it could increase demand for different sizes and types of aircraft.

The centerpiece of the Federal Government's effort to modernize the U.S. airport and airway system is the National Airspace System (NAS) Plan, now three years behind schedule. Despite anticipated improvements resulting from the NAS Plan, one recent study indicates they will not add greatly to the capacity of the air traffic control (ATC) system. Aviation officials believe that real capacity increase can come only from new airport construction. However, airport expansion is being slowed both by a lack of funding and local community opposition. Today, only two new airports are in the planning stage.

Airport and airway congestion will clearly be a long-term problem requiring dedicated efforts to arrive at a solution. Important to resolving these problems is an understanding of the difficulties facing operators and manufacturers of commercial jet transports, general aviation aircraft, and helicopters.

CONCLUSIONS

- Taken together, the problems and costs associated with the lack of capacity could impose unnecessary restraints on the services being provided, on the economy and on those sectors that depend upon air carrier services.
- To date, the effects of congestion on civil aviation manufacturers have spurred demand for their products and services, e.g., the purchase of larger aircraft. By 1999 this trend may reverse itself and demand could be curbed by the limitations imposed by the transport system.
- The most effective way to increase airport and airway system capacity to the degree demanded by the public is through the construction and expansion of airports. So far, construction efforts have been slowed by local opposition based on environmental concerns of noise, ground congestion and safety. In many cases, over time, airports have become surrounded by noise-sensitive residents and/or hemmed in by neighboring communities. Funding is also a problem.
- There are 39 new runways which have been approved for construction between now and 1999, but projected spending will not be adequate to complete the work. Central to the funding issue is the controversy surrounding the use of the Aviation Trust Fund. A determination must be made as to who should pay for ATC operations, ATC research and development, and airport improvements and at what amounts. Without additional capacity, air service will be constrained and U.S. economic growth will be affected accordingly.
- Constraints in capacity may also indirectly lead to re-regulation in the form of slot-allocation at airports.

- The primary problem facing airlines and manufacturers in meeting the public's noise concerns is the patchwork of community noise regulations and the lack of a federal noise standard. An important factor weighing on an airline's purchase or modification decision is the fact that even after being modified with a hushkit, some aircraft have not been accepted at certain airports because local noise ordinances are at variance with those of other communities. If airlines are to be required to make a major investment in noise kits, there must be some guarantee that there will not be local discrimination against their planes.
- The airport and airway system is complex and actions taken to improve one facet of its operation can have different and at times unforeseen consequences on other facets or locales. As a result of the East Coast Plan, which restructured air routes, enroute noise has become an issue in some communities. The enroute noise problem could become more widespread if the FAA implements routing changes in other air corridors. However, enroute noise levels generally are too low to cause concern about public health and welfare, based on current noise criteria established for disturbing sleep and speech.
- Civil regulatory agencies in the United States and in Europe are subjected to pressures to increase the stringency (beyond stage 3) of the existing noise rules. These pressures are primarily the result of adverse public reaction caused by the higher noise levels of stage 2 airplanes that dominate the commercial fleet. Since there are no technologies on the horizon which can lower engine noise beyond stage 3, a move to adopt more stringent noise regulations will impede the design and development of new and derivative aircraft. Such a move could also disrupt the planned financial amortization of the existing fleet. Given current projections, the noise situation around airports will improve significantly as stage 2 airplanes are replaced by quieter stage 3 airplanes. If noise rules become more stringent, the resulting costs incurred by the manufacturers and the airlines would in turn be passed on to the travelling public. Since technology does not currently exist to quiet aircraft beyond today's requirements, the public would pay these higher costs without receiving significant noise relief benefits around airports.

RECOMMENDATIONS

- Institute a national aviation policy which coordinates all aviation policy efforts. Such a policy should include the integration of state-level efforts and set long-term goals for achieving an airport and airway system that serves *national* needs. It should include long-term goals to lay out where the airport and airway system should be headed, how it should get there, and what the projected costs will be.
- Explore the possibilities of developing new approaches to planning and technology development as they relate to the future national airspace system. A broader system concept may facilitate the development and application of new technologies, rather than developing technologies individually as needs are identified. This would require an integrated approach to designing commercial air transportation system requirements. Consequently, when new technologies are introduced, all related subsystems of the airspace system would be tied together and updated accordingly - e.g., new onboard technologies could be adapted to newly installed related ground control systems.
- Continue funding the Airport Improvement Program (AIP) and promote the development of city-center heliports. The concept of wayports - airports located away from populated areas and used as transfer points for airlines - should be further explored, as should the conversion or joint use of military air bases by commercial traffic.
- Dedicate a greater share of the Aviation Trust Fund money for AIP projects. Once authorized, these funds must be appropriated in full. Another option to be explored is establishing a separate funding mechanism exclusively for airport work.
- Encourage localities to accept airports in their communities. Arguments should emphasize the economic benefits that airports and air transport generate. Also implement compatible land-use policies near airports which allow for future airport expansion as well as mitigating noise concerns.
- Continue implementation - aggressively - of the National Airspace System Plan.

- Adopt a national noise policy that would benefit both the public and industry (manufacturers and airlines). This policy should define appropriate methods, and schedules for replacement of stage 2 airplanes, or their conversion to stage 3. The useful life of stage 3 aircraft should be protected.
- Collect and assess additional information regarding enroute noise before taking legislative action. Conduct cooperative fact-finding studies by the FAA, NASA, the manufacturers, and the airlines concerning this issue. Determine whether there is any need for rule making.
- More stringent noise limits should not be proposed until it has been established that there is a need and that quieter aircraft are technically and economically feasible. The government should support noise research, keep informed of the state-of-the-art in engine noise reduction technology, and monitor the impact of noise on the population so that future noise regulations will continue to be realistic and effective.
- Determine the total financial burden that new noise and technology requirements impose on aircraft operators and schedule compliance timetables in such a way as to allow operators to digest the costs without suffering undue financial strain.
- Once FAA-mandated equipment has been certified, airlines should be given enough time to equip their fleets with the new equipment in an efficient manner, i.e., installing the equipment during routine maintenance schedules.
- More flexibility should be factored into the development schedules of suppliers who are developing and producing state-of-the-art technology.

NATIONAL AIR TRANSPORT CONGESTION AND CAPACITY PROBLEMS: THEIR IMPACT ON THE AVIATION INDUSTRY

There is widespread agreement among the aviation industry and the travelling public that current airport and airway overcrowding poses a serious problem. Since the U.S. airport and airway system is fully integrated into the fabric of the national economy, its ability to transport people and goods at reasonable prices and without delays is instrumental in spurring domestic economic growth. The continuing rise in the demand for air service underscores this importance - in 1978, 278 million passengers boarded at U.S. airports; during 1986 this number rose to 415 million; by 1999 the figure is projected to reach 714 million.¹ Those directly dependent on the airport and airway system include business and personal travellers, airline and small aircraft operators, airport operators and personnel, aircraft and related systems and parts manufacturers, and the aeronautical services. Also affected are the vacation industry and companies who use air service for cargo and package deliveries. Because the airport and airway system is so vital to U.S. commerce, its growing congestion has serious economic implications for the nation.

Pivotal players within the airport and airway system are the commercial aircraft and engine manufacturers whose products and services provide the means of transport. The manufacturers' ability to meet the needs of their airline customers, and ultimately of the public, by developing and applying technology in a timely and cost-effective manner is complicated by the system's lack of capacity. This lack of capacity creates market uncertainty and has the potential for adversely impacting future sales. By creating delays, decreasing safety margins, limiting access to certain airports, and contributing to community noise problems, congestion also inconveniences the public and increases costs to the airlines. These costs are passed along to customers through higher ticket prices and delays. If costs decrease the demand for air service, the airlines will experience reduced profits and be less able to invest in the aircraft necessary to serve the public. Even if demand is not adversely affected in the short term, regulations that require premature retirement of aircraft, reengining or engine modifications, or installation of new onboard avionics for safer operation may be imposed on operators before they are financially prepared to incorporate them. The impact on the airline industry, which has recovered in recent years from the severe financial de-

pression that followed deregulation, could be enormous. In turn, congestion could restrain the now promising demand for U.S. manufactured aircraft and impose unnecessary brakes on the economy.

An assessment of congestion's effect on the airlines and the aircraft manufacturing industry cannot rely upon a precise cause and effect relationship. Airline decisions to purchase or modify aircraft are based on multiple economic criteria; congestion-related factors are only part of the equation. Complicating the issue is the fact that aircraft product development cycles are relatively long, and changing economic conditions and other factors make it difficult to project the needs of the travelling public into the next century. Nevertheless, it is possible to draw some conclusions regarding areas where appropriate policy implementation will provide an environment for solutions.

Airport and Airway Congestion - The Problem

There are more than 5,000 public airports in the United States and most can service the public without difficulty. Congestion occurs only at some of the very largest hubs - the 50 busiest airports that handle 80 percent of all airline boardings - and except during bad weather, they experience problems only during certain hours.² Unfortunately, when congestion occurs at a number of key locations, delays can be transmitted throughout the air transportation network.

Since the Airline Deregulation Act of 1978 - which phased out controls on air fares and travel routes - fare prices have dropped and air traffic has increased dramatically. As a result, delays are now a common occurrence. During 1986, the Federal Aviation Administration (FAA) reported an average delay of greater than eight minutes per operation at 11 airports. By 1996, the FAA expects that number to include 29 airports.³ The FAA estimates that delays in 1986 cost the scheduled air carriers and their passengers up to \$5 billion.⁴

The increasing demand for air service is not expected to abate in the near future. Domestic enplanements are forecast to increase by 4.6 percent annually between 1987-1999, reaching 714 million.⁵ An FAA listing of the 29 largest hubs shows that all are expected to experience increased traffic by the year 2000 and activity at 12 will climb by over 100 percent.⁶ The Transportation Research Board, using revenue passenger miles as their unit of measurement, has made preliminary projections indicating that, by 2050, air traffic should increase from two to six times that experienced during 1986.⁷

Inadequate Solutions

The centerpiece of the Federal Government's effort to modernize the U.S. airport and airway system is the National Airspace System (NAS) Plan. The NAS Plan, launched in 1981, is made up of 90 projects. Its primary focus is the creation of an Advanced Automation System - a computer system which will allow air traffic controllers to monitor aircraft, flight routes, weather, congestion, etc., all on one color-coded screen. Along with this effort, the Federal Government is directing the Airport Improvement Program (AIP) to upgrade and expand the nation's existing airports.

Due to the technical complexity of the NAS Plan, as well as difficulties in obtaining congressionally authorized funding, various projects are, on average, three years behind schedule.⁸ In addition, although the Plan will make the air traffic control (ATC) system more efficient, a recent Congressional Budget Office report concluded that it would not add greatly to the capacity of air traffic control. The Government's AIP effort is also being held up. Airport expansion is being slowed by a lack of funding and by local opposition concerned about the environment. Funding problems are due in part to questions concerning how money in the Aviation Trust Fund should be spent.* As a result of the disagreements money has not been spent.

All aviation officials believe that real capacity increases can come only from the construction of new airports. Former FAA Administrator Allan McArtor stated that the nation needs up to 12 new airports over the next 20 years. Unfortunately, the construction of new airports is moving very slowly. Major new airports

* The Trust Fund is supported by aviation user fees and fuel taxes. It is set up to support ATC operations, ATC research and development, and AIP activities.

can cost \$3 billion to build and take anywhere from 10 to 20 years to complete. The United States has not opened a major airport since Dallas-Fort Worth in 1973. Only two airports are planned for the future - one in Denver, Colorado and one in Austin, Texas - and the Denver effort is being slowed because of disagreements between the city and the air carriers who currently use Denver's existing facility.

IMPACT OF CAPACITY PROBLEMS ON AIRLINE OPERATORS AND AIRCRAFT MANUFACTURERS

Airport and airway congestion, it appears, will be a long-term problem. An understanding of the burdens imposed upon the airlines and aircraft manufacturers by congestion should provide insight into the necessity for renewed policy efforts, appropriate levels of funding and a reasonably paced imposition of change in aircraft and engine technical standards. In the following pages, the impact of congestion-related change on manufacturers and operators of large commercial transports, general aviation aircraft and helicopters are examined.

COMMERCIAL TRANSPORTS

Some of the issues that arise with respect to the impact of congestion on the manufacturers and operators of commercial jet passenger aircraft include:

- the need for new avionic systems to improve flight safety in heavily travelled skies;
- the impact of community noise rules; and
- the demand for larger capacity aircraft to service busy airports.

New Technology Requirements - In order to maintain safety and improve flight efficiency to relieve congestion, the FAA is pursuing new technologies with industry in the field of avionics. Two technologies are particularly important to the FAA - Traffic Alert and Collision Avoidance Systems (TCAS) and Microwave Landing Systems (MLS). (Mode S is the other major technology being pursued by the FAA.)

Although the International Civil Aviation Organization (ICAO) has not yet endorsed TCAS, the FAA does require that all commercial aircraft (larger than 30 passengers) flying in the United States be fitted with TCAS II by 1991. All TCAS versions (I, II, and III) will

link with transponders on near-by aircraft to provide pilots with a dot display of aircraft locations. TCAS II and III will also provide pilots with advisory commands which will enable pilots to initiate maneuvers for avoiding an accident. TCAS may also be used to reduce airflight separations, thereby increasing the number of landings at a given airport and increasing capacity. TCAS II costs approximately \$125,000 per aircraft.⁹ The total cost to airlines for acquiring, installing, and training flight crews on TCAS could reach \$500 million.¹⁰

The FAA is also attempting to replace the current Instrument Landing System (ILS) with MLS. MLS became the official international guidance landing standard in 1978. The ILS limits aircraft landing runs to a single straight-in approach; the MLS permits multiple curved approaches. MLS should help relieve congestion by providing greater landing flexibility, while also providing a noise-reduction advantage by allowing airlines to approach airports over less-populated areas. The transition date from ILS to MLS is 1998, established by the ICAO. Nevertheless, opposition aimed at delaying MLS is strong. Airline operators claim that the increasing cost of MLS and the recent enhancements of ILS make the MLS capabilities less important. The cost to airlines of installing the system is estimated by the Air Transport Association (ATA) to be up to \$500,000 per aircraft.¹¹ The General Accounting Office projects that airlines will have to spend about \$5 billion to equip their aircraft.¹²

The installation of TCAS, MLS and similar technologies will increase air safety and add limited capacity. They will also impose costs on aircraft operators. Older aircraft might have to be prematurely retired because the added cost of installing these systems may not be justified based on the projected economic return of the aircraft. Also, airlines might have to adjust their strategic planning budgets to accommodate the costs of adding the technology to their fleets.

The FAA estimates that their TCAS ruling will affect 3,364 existing U.S. transports and an additional 3,100 that are expected to be added by the year 2003.¹³ For airframe makers, the inclusion of new avionic systems into their production lines is not a problem when sufficient lead-times are set (generally about 15 months). Current FAA timetables for TCAS provide that lead-time; no FAA compliance dates have been set for MLS. U.S. avionics suppliers, on the other hand, may face

problems getting their products tested and installed by FAA deadlines. MLS is already two years behind FAA development schedules due to software coding complications. In the case of TCAS, the production lines of suppliers are not expected to be ready until late 1989, limiting the time allowed airlines to outfit their fleets. Instead of following their preferred maintenance schedules to get the work done, large carriers will have to contract the work out and take additional carriers off flight service to meet the deadline. This increases aircraft downtime and increases costs. Furthermore, since TCAS is new, many in the industry believe that more testing is needed before full compliance should be required; consequently, congressional deadlines should be pushed back. It has been recommended that the technology should be phased in over time. In this way, if flaws are uncovered, only a few aircraft will need adjustments instead of the entire U.S. fleet.

Industry is also investigating technologies, which if applied, would give aircraft operators greater capability and control of their aircraft. Examples of such technologies include systems which: relay maintenance, performance and position data for real-time, uninterrupted communication via satellite for use by ATC and the airlines; and allow navigation/guidance performance surveillance via satellite position determination for comparison against on-board systems. A critical question facing avionics developers is how to adapt these advancements to the emerging air transport system. Currently, if a NAS requirement need arises and the required technology is available, the NAS is selectively upgraded to deal with the specific deficiency. This kind of environment limits the effectiveness of adapting more forward-looking technologies which need integration with other parts of the NAS subsystem to perform at their full potential.

The Noise Issue - Impact of Community Noise Rules

Noise is both a cause and a symptom of the congestion problem. Today more than 400 U.S. and 60 European airports have instituted noise reduction rules which restrict flight operations. Some restrictions limit the time of day that aircraft can use their facility, e.g., National Airport in Washington D.C. allows only 13 flights between 10 p.m. and 7 a.m. While lowering noise levels, these actions may add to the congestion problem by forcing airlines to schedule their landings during the more congested daylight hours. The noise issue is also

the foremost environmental issue used to resist the construction of new airports and the expansion of existing facilities which would add to capacity. On the other hand, congestion has created *additional* noise problems. For example, the rerouting of North-East corridor air traffic to provide more efficient routes resulted in increased overflights and noise problems for suburban communities in New York and New Jersey.

Currently, airports have the authority to draft their own noise standards and set up internal noise measurement schemes. The FAA has not taken a position on the proliferation of individual noise rulings nationwide, although U.S. authorities are considering proposals drafted by the U.S. Industry Task Force on Airport Capacity Improvement and Delay Reduction. Similar proposals are being considered by European officials. All of these proposals would set noise standards which 71 percent of the world fleet and 63 percent of the U.S. narrow-bodied fleet currently do not meet.^{14,15} These aircraft are considered stage 2 based on noise standards agreed to by the International Civil Aviation Organization (ICAO) and the FAA.* Most aviation officials expect the passage of federal noise regulations in concurrence with these proposals by 1990. The dates selected to phase out stage 2 aircraft could force fleet operators to prematurely retire their affected aircraft, modify their engines, or have new engines installed. It has been projected that the cost to airlines of replacing current stage 2 aircraft would be \$75 billion.¹⁶ Since the airline industry is very diverse, airlines will be affected differently and their choice of action will be based on economics.

The financially weaker airlines could be forced out of business. This situation would reduce the number of flight service competitors in operation and could result in higher ticket prices. Currently, stage 3 aircraft are not being purchased as replacements for noisier stage 2 aircraft, but as fleet additions, because of increasing passenger demand. Stage 2 aircraft are being left in service. As a result, the premature retirement of aircraft could in turn reduce passenger capacity. Whatever steps the airlines take to abide by new noise regulations, their response will directly impact the engine and airframe manufacturers.

* In conjunction with ICAO's agreements, the FAA established aircraft noise rules for U.S. flights under the headings stage 1, stage 2 and stage 3. Each successive stage represents a quieter aircraft standard. Aircraft noise includes both airframe and engine noise. Stage 1 aircraft are banned in the United States; the current debate concerns phasing out stage 2 aircraft.

The Effect of New Noise Rules on Engine Development

- Aircraft noise has always been a major design consideration for both engine and airframe manufacturers. The airframe contributes to the total noise problem, particularly during aircraft approach when landing gear and flaps are extended. There is currently debate concerning how much noise the airframe generates and what can and should be done to reduce this problem.

From the engine standpoint, during the initial engine development phase, manufacturers do commit a significant amount of time and expense testing and developing noise reduction designs. The high bypass engine, which made powerplants more fuel efficient, also made them significantly quieter because it reduced the noise associated with the high velocity exhaust of the jet. As a result, the fan and/or other turbomachinery components of the engine became the major contributors to noise. Industry and government agencies have committed substantial resources over the last 15 years to develop methods to reduce the noise levels of these sources. Successful application of this technology includes the use of acoustical treatment (liners), increased number of fan exit guide vanes, increased spacing between the fan rotor and the exit guide vanes, and the increase of the inlet blow-in doors. Some of these noise reduction features increase weight, drag, manufacturing complexity and cost, and therefore they decrease engine system performance. The specific dollar amount that noise reduction features add to the final price of the aircraft cannot be determined. The design process is one in which all engine requirements are integrated - thrust, weight, fuel consumption, emission, stability, produceability, and noise - and it is next to impossible to separate out the cost of each particular requirement.

The possibility of new, mandated, lower noise limits for airplanes presents problems for manufacturers because the body of noise reduction technology is now reasonably mature. There is concern within the industry that standards could be established that cannot be met by current noise reduction technology.* The achievement of stage 3 noise limits requires the best currently available noise reduction technology for new aircraft and their derivatives. Small improvements in noise reduction technology that have occurred since the adoption of the existing stage 3 noise standard, are applied to allow de-

* As noted in recent industry (ICCAIA) and FAA working papers to ICAO's Committee on Aviation Environmental Protection Working Group I (third meeting held in Berne, Switzerland on January 18-20, 1989).

rivative airplanes to meet the current noise limits. Aircraft that will be powered by the highly fuel efficient new propulsors - i.e., propfans, the unducted fan, and the ultra high bypass ratio engine - are expected to have noise levels comparable to those of recent stage 3 airplanes.

Future supersonic and hypersonic airplanes will be most likely powered by powerplants different from today's engines. It is, therefore, too early to set or dictate rigid noise limits. However, the goal is to meet the stage 3 noise limits. Complicating the noise problem is the fact that some local airports have used a variety of noise measurement procedures to apply restrictive noise limits which appear to be lower than the stage 3 limits. These varying local noise regulations can be met only by constraining the airplane operation to less than design capability, including reduced thrust and reduced payload and/or range.

The current public outcry regarding enroute noise creates another problem that manufacturers may not be capable of solving. The East Coast Plan (ECP) was implemented to redesign flight routes to provide greater efficiency and help control crowded airways. (The FAA is considering similar plans for the Los Angeles and Chicago areas.) As a result of the ECP, air carriers have saved \$80,000 a day,¹⁷ but concurrently, the Plan has increased flights over some New Jersey suburbs, prompting residents to complain about noise. Both the FAA and the engine manufacturers agree that not enough is yet known about the problem to merit specific action. The FAA is conducting a study of the issue. In some cases, the agency has discovered that the problem does not concern noise, but rather, the invasion of privacy.

The Effect of New Noise Rules on Engine and Aircraft Sales - As has been noted, new regulations calling for a halt in operation of stage 2 aircraft will increase the financial burden on airline operators by forcing some operators to prematurely retire, reengine, or modify engines of existing aircraft. In short, noise requirements add costs without adding revenue. The first result of new regulations would be to alter the evaluation of new-versus-used equipment. By raising the costs of continuing to operate older planes, these regulations make the replacement of these aircraft more attractive. At the same time, a dramatic change in noise regulations might dampen sales of new airplanes by wiping out residual values of stage 2 aircraft held by airlines and leasing companies. Appraisal experts expect a drop in value of stage 2 aircraft of up to 60 percent over the next five years.¹⁸ Such

declines in asset values will make it more difficult for some financially weaker airlines to finance new aircraft.

Modifications of older aircraft will create a new market for various manufacturers. Such modifications will extend the life of some aircraft by providing quieter engines with improved fuel efficiencies. On the other hand, the demand for new aircraft requiring new engines may suffer. Currently, 3,550 aircraft operating in Europe and the United States do not satisfy the requirements for stage 3.¹⁹ The average life of these aircraft is 15.6 years, with almost 30 percent (1,000) having performed merely 10 years of service or less.^{20*} The question that airlines must ask is whether extending the life of their older planes will result in revenues which balance the added costs of buying a hushkit or reengining an aircraft. The answer, based on an airline's financial standing and route strategy, will determine the actual number of units which will be converted versus retired. This situation is complicated by the fact that some airports have not accepted hushkits. Recently, the San Francisco International Airport banned a Burlington Air Express hushkit-equipped Boeing 707. Some manufacturers are expected to price hushkits between \$1-2 million for a DC-9 and 737.²¹ A reengine program will cost more. The total conversion cost for a DC-9 is estimated to be \$8 million.²² Rolls Royce estimates that the reengine market could include up to 1,700 aircraft.²³

The Demand for Larger Aircraft

Since deregulation, U.S. airlines have fashioned their fleets around smaller aircraft, a trend that made Boeing's 737 series (100 - 150 passengers) the world's best selling jetliner. This aircraft size worked well in the hub-spoke environment that developed, because its relatively low purchase price and operating costs allowed airlines to augment their fleets and increase their departure frequency at hubs.

To increase capacity at crowded hubs, airlines are now altering their fleet mix by adding larger aircraft to transport a greater number of people per flight. This trend is also prompted by the growth in Pacific Rim traffic, which requires aircraft that can accommodate long-range travel. Manufacturers' order books reflect the move toward larger aircraft. Orders (both confirmed

* Today, many commercial aircraft are still in service after 25 years.

and options) for Boeing aircraft that carry over 150 passengers have increased since 1985 with a dramatic climb occurring in 1987. From 1981 through 1984 orders averaged 39 per year, between 1985 and 1987 they averaged 125.²⁴ Statistics collected by the *Avmark Aviation Economist* covering orders from 1978 to 1987 demonstrate that 1987 was a record year for total wide-body orders.²⁵

Several factors will determine the transitional pace from smaller to larger aircraft. If fuel prices rise dramatically, operators will have an incentive to retire their older planes for newer, more fuel efficient models. Also, if tougher noise regulations are enacted, airlines will be prompted to purchase new, quieter models. In both cases, larger replacements would probably be purchased. In addition, if an air carrier dominates a hub, it faces less competition and therefore less incentive to increase departure frequencies (which passengers favor) based on smaller aircraft. Consequently, such a carrier may be more inclined to move towards larger aircraft than other airlines who are fighting to maintain passenger demand. A final factor is the economy. If an economic downturn occurs and passenger traffic drops, airlines will be forced to cut costs and the retirement of older smaller planes is one option.

The move into larger-capacity aircraft should continue. At the 21st Technical Conference of the International Airline Transportation Association all three commercial transport manufacturers agreed that higher capacity aircraft would be the future trend. Boeing's Director of Market Research, Thomas Craig, said that half of all seats delivered between 1994 and 2000 would be in long-range airplanes seating more than 300 passengers.

To meet this demand, transport manufacturers are designing airplanes which, in most cases, will accommodate more travellers than the aircraft they are expected to replace. Engine manufacturers are complementing this effort by designing larger thrust, quieter powerplants. The two U.S. large airframe manufacturers, Boeing and McDonnell Douglas, are stretching their current models for the 1990s and evaluating the introduction of much larger derivatives for service into the year 2000. Boeing, for example, is considering whether to offer aircraft featuring increased speed or greater capacity. A supersonic transport called the High Speed Civil Transport (HSCT) is being studied by Boeing and McDonnell Douglas as part of a National Aeronautics

and Space Administration project. The HSCT could be developed for service by the year 2000 and reduce current flight times of between 10-14 hours by up to 75 percent. One model shows a Mach 2-3 aircraft carrying 250 passengers. This concept is being examined against the development of an enlarged 747, designated the 747-XXX, which would accommodate 100-150 more passengers than the existing 747-300. McDonnell Douglas is studying the merits of one or two versions of its MD-11. It may produce a Medium Range Stretch (MRS) and later introduce a derivative called the Super Stretch (which would have the same capacity as the MRS but greater range), or it may bypass the MRS and move directly into the Super Stretch.

Larger aircraft will not alter the travelling public's environment while flying. The biggest impact will occur after the plane lands. Passengers generally move through the disembarkation procedure in a crowd and, when several large airplanes arrive consecutively, the crowd sizes increase accordingly; if not adequately managed, delays will result.

Today's airports should not have difficulty handling fleets of larger aircraft. As required, modifications to accommodate newer transports have been made. Nevertheless, some airports have special limitations unique to their situation which constrain airplane design options. Service for the HSCT will necessitate airport modifications. Its height may necessitate new service vehicles and its longer wheelbase would require changes of taxiway turn fillet areas. Strengthened runways would also be required.

REGIONAL AND GENERAL AVIATION

Some of the issues related to congestion which impact the regional and general aviation industry include:

- airport access and costs; and
- the need for new avionic systems to improve flight safety in heavily travelled skies.

Airport and airway congestion is a leading issue for both regional and general aviation industries. Regional airlines fly scheduled short-haul (160 miles) routes, connecting outlying business travellers to the

major airlines at hub centers. General aviation aircraft typically are used for unscheduled business and recreational short-haul flights. Since their load factors are traditionally lower than those of larger transports, new costs must be spread over relatively fewer seats. Consequently, added costs due to congestion-related factors will have an immediate impact on these cost-sensitive air carriers.

Airport Access - There have been efforts to limit the landings of regional and general aviation aircraft at airports as a means of reducing congestion. Both government and private initiatives have been undertaken.

The Massachusetts Port Authority (Massport) effort at Boston's Logan Airport is a recent example of a private initiative. On July 1, 1988 Massport authorities imposed a sliding scale of fee charges which raised landing fees while lowering the dollar per pound costs per aircraft. These charges fell proportionally higher on smaller airplanes than on larger aircraft. (The landing fee for a Boeing 747 declined by 52 percent, while the fee for a Cessna 402 increased by 264 percent.)²⁶ This policy was enacted to increase passenger throughput by discouraging smaller aircraft. Similar fee structures are being considered by other major airports. In December 1988, the U.S. Department of Transportation ruled that the Massport fee structure was illegal and threatened to cut off airport grant money if the policy was not revoked. Massport immediately lifted the fee structure, but is appealing the ruling in court. An economic study conducted by the Regional Airline Association (RAA) concluded that if the Massport plan continued, smaller aircraft would have been forced to raise their fares up to 24 percent to cover the higher landing costs.²⁷ This would result in a decline in air travel business of almost 250,000 passengers annually.²⁸ Economics suggest that if such policies were instituted on a regional or national basis, declining small aircraft service would hurt not just the public served but aircraft sales as well.

In 1969, the Federal Government permitted four airports - Chicago-O'Hare, Washington-National, New York-JFK, and New York-LaGuardia - to implement a slot allocation method to control landings to increase safety. The slot method is not considered a major constraint on general aviation or regional aircraft traffic because the measures mandate that a specific number of slots be set aside for both categories of operators. The FAA is not planning to extend slot controls to other facilities under current conditions.

New Technology - One equipment change facing general aviation operators is the need to equip their aircraft with TCAS. In January 1989, the FAA stated that carriers with 30 or fewer seats would have to install TCAS I within six years. Prices for TCAS I may be set near \$30,000 per aircraft, though the equipment is not yet available.²⁹ The potential market for TCAS I will include over 220,000 aircraft.³⁰ Installation costs will have a significant initial impact on the industry, but sales decisions for new aircraft - which have been relatively low since the late 1970s - should not be affected.

For regionals the cost will be more expensive. The RAA projects that installation could run as high as \$250,000 for regional aircraft.³¹ Larger aircraft will be required to install TCAS II within three years. Many air carriers will have to weigh the economic benefits between retiring older planes versus installing the equipment. The U.S. regional fleet numbers approximately 1,900.³² The installation of TCAS II on regionals will be complicated since they have small cockpits and their aircraft models are less standardized than large transports.

Other Issues (Noise and New Designs) - Noise is generally not an issue with regional or general aviation operators, since neither group is dominated by jet aircraft. However, general aviation operators are concerned that a blanket stage 2 noise ban will be implemented. The noise classifications for general aviation aircraft versus larger commercial transports are different and stage 2 general aviation aircraft are quieter than many stage 2 large transports.

Congestion should not alter the operating strategies of either category of aircraft and as such, aircraft designs should not change dramatically. General aviation aircraft service mostly secondary airports; their share of traffic at the major U.S. hubs is only 12 percent.³³ In fact, general aviation is promoting its point-to-point service, its avoidance of congested hubs, and its on-time record in a major marketing effort now underway. Currently there are no trends towards purchasing larger aircraft. For regionals, there is also no move towards larger aircraft based on capacity considerations. Their mission is to develop outlying markets and this strategy is not economically feasible by introducing larger aircraft into small communities. Regionals will continue to feed the major airlines at hubs and therefore there is a move towards faster planes to help meet connecting schedules. The recent introduction of the SAAB 200 aircraft featured its increased speed.

COMMERCIAL HELICOPTERS

Some of the issues related to congestion which impact the helicopter industry include:

- o the need for new avionic systems to improve flight safety in heavily travelled skies;
- o the need for a system of city-center heliports; and
- o the introduction of new models of rotorcraft.

The helicopter industry believes that it can provide some solutions to the congestion problem by enhancing its role of transporting passengers from downtown to airports, as well as from heliport to heliport. Consequently, the growing capacity problem at hubs should provide an opportunity for the industry.

New Technology - The inability of the FAA and industry to determine what congestion/safety related avionic systems should be required on rotorcraft is viewed as a potential problem facing the industry. Because of its unique operating environment, the needs of helicopters are different than those of fixed-wing aircraft. Technology currently being explored for fixed-wing applications (e.g., TCAS, MLS) do not adapt well to rotorcraft.

New Heliports - Compared to fixed-wing aircraft, helicopters are more expensive to operate, consequently to compete they must capitalize on their convenience and time saving capabilities. This makes the existence of city-center heliport systems vital to the industry's future growth. Currently, such a system does not exist and progress has been slowed by the public's concern over safety and noise. The FAA is promoting the development of city-center heliports through its National Prototype Heliport Demonstration and Development Program. The FAA is planning to budget \$2 billion for construction of heliports into the next century.³⁴

New Models - Several new models of rotorcraft are being explored as possible products for the mid-1990s and beyond. The Very Large Civil Transport (VLCT) is one concept being studied by industry to address the capacity problem. The initial versions of the VLCT are expected to carry between 75-100 passengers and could be available by 1999. Another concept is the tiltrotor, which has rotors that can be tilted into a vertical position for lift-off and then positioned horizontally for cruising. Two recent studies have concluded that derivatives

of the V-22 (the military tiltrotor prototype) could be economically feasible for short-haul activities if vertiports and appropriate air traffic control systems are built.* The tiltrotor could capture 10 million of the projected 120 million passengers who are expected to fly through the New York City area annually by the year 2000.³⁵ A recent government forecast suggests that a demand could exist for 1,200 tiltrotors by the year 2000.³⁶ Commercial versions probably will not be available until 1995. Nevertheless, there are questions concerning the tiltrotor's commercial viability due to its high purchase price and operating costs. A third but longer term concept is the X-wing aircraft, which uses helicopter blades for lift and then positions those blades into a locked X-shaped configuration for cruising. This concept is being explored by NASA and the industry, but the technology necessary for such flight has not been adequately developed. If successful, the X-wing should provide higher cruising speeds than the tiltrotor.

Other Issues (Noise) - New noise standards for civil helicopters became effective in February 1988. These regulations were in line with ICAO standards and therefore only a one-time certification is required for overseas marketing. Progress in helicopter noise reduction is due in part to the cooperation between the FAA, NASA, and industry in setting up the National Rotorcraft Noise Research Program in 1982.

Summary

The technical problems and tradeoffs associated with each industry sector's role in the airport and airway system are considerable, as are the costs. At the same time, there are solutions. What is needed is a long term and comprehensive approach to planning that will generate the best possible solutions.

* The difference between heliports and vertiports is one of mission; vertiports are for tiltrotor aircraft; heliports support helicopters.

FOOTNOTES

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⁴ Federal Aviation Administration, *Airport Capacity Enhancement Plan 1988*, DOT/FAA/CP/88-4, p. 1-11.

⁵ FAA, *FAA Aviation Forecasts*, p. 46.

⁶ *Ibid.*, p. 115.

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⁹ "TCAS Grabs Limelight," *Interavia*, August 1988, p. 722.

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¹³ "FAA Orders Aircarriers to Install Collision Avoidance Systems," *Aviation Daily*, January 6, 1988, p. 27.

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²⁴ Drexel Burnham Lambert, *Aerospace/Defense Quarterly*, October 1988, p. 114.

²⁵ Paul Williams, "Resurgence of the Widebody," *The Avmark Aviation Economist*, December 1987, p. 8.

²⁶ David Hughes, "Massport Passes First Phase of Fee Increases at Logan," *Aviation Week & Space Technology*, March 21, 1988, p. 75.

²⁷ David Hughes, "RAA Estimates 239% Increase in Fees For Small Carriers Under Massport Plan," *Aviation Week & Space Technology*, March 7, 1988, p. 62

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²⁹ "TCAS Grabs Limelight," *Interavia*, p. 722.

³⁰ General Aviation Statistical Databook, *Number of Active General Aviation Aircraft in 1986 By Type and Primary Use and General Aviation Hours Flown by Aircraft Type and Primary Use 1986 (Thousands of Hours)*, 1988 Edition, p. 10.

³¹ *Regional Aviation Weekly*, November 27, 1987.

³² Regional Airlines Association.

³³ General Aviation Manufacturers Association, *Statistics*.

³⁴ "Special 10-Page HAI Convention Issue," *Helicopter News*, February 3, 1989, Vol. 15, No. 2.

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