AIR TRANSPORTATION SYSTEM CHANGES WHICH WILL IMPACT AIRCRAFT AND AIRPORT COMPATIBILITY

Philip H. Agee, Air Transport Association of America

Abstract

Forecasts of future air travel and rate-of-growth of the market are examined. The results of work by the FAA, ATA, and a private research group are compared and analyzed. It is suggested that the data indicate that the markets exhibit characteristics of maturity. The nature of the service industry as it will influence aircraft/airport compatibility is discussed, and although difficulties in predicting detailed changes in structure are apparent at this time, the implications are that deregulation will impose a dynamic future on the industry. An analysis of aircraft utilization indicates that since fixed costs, brought about by replacement of equipment, will dominate the future, emphasis will be on high utilization. Factors involved in predicting the impacts on airports of specific system, aircraft, and fleet changes are reviewed, and it is concluded that generalizations are very risky; rather, each case must be considered on an individual basis.

Before the future changes in and impacts of the air transportation system can be assessed, the forecasts of future travel and its growth rate must be examined, and the impact and rate of impact on the growth of passengers, and what impact this will have on the system changes must be determined. Forecasting is a difficult task, but it must be done. The Air Transport Association (ATA) has a responsibility to engage in the art of forecasting, as does the FAA.

Future Traffic Growth

At its annual Forecasting and Planning Review Conference in early October, 1981, FAA indicated that domestic passenger enplanements were estimated to grow at a rate of 4 percent per year over the period of 1980-1993. This translates to enplanements growing from about 280 million in 1980 to 470 million in 1993. The ATA "Domestic Industry Passenger Demand Forecast", developed in 1975, and most recently updated in 1980, is very close to that of the FAA. It projects a 4.5 percent growth per year through the year 2000. Since the ATA forecast is on a lower base and includes a smaller number of carriers, when scaled up to the FAA base, the market is forecast to reach about 620 million annual domestic passenger enplanements by the year 2000. Domestic revenue passenger miles (RPM's) are expected to grow at about 5 - 5.5 percent per year.

For United States international air passenger traffic (to and from the U.S.), ATA is currently projecting an average growth of 5.7 percent per year in the period 1980 to the year 2000. This is down slightly from the annual 6.0 percent which was forecase in 1976. In RPM's an annual growth of 6.5 - 7 percent appears reasonable internationally.

With regard to cargo, the ATA forecast includes the combined domestic and U.S. connected international enplaned cargo tons. It shows the average annual growth rate of 6.4 percent between 1980 and 2000, which is down from the figure of 7.2 percent per year which was forecast in 1978. In actual numbers this represents an increase from 4.6 billion tons at present to 16 billion tons in 2000.

To summarize these forecasts, it appears that deregulation may have had a short term stimulating effect, perhaps coupled with good economic years in 1978 and 1979, resulting in double digit growth rates. However, in 1980 and 1981 the national economic climate has brought the growth rate back down, making the projection of a steady average increase at the levels cited above appear to be quite realistic. The market gives every indication of being mature, and so it might be expected to plot a relatively steady course driven by those factors which went into the original projections.

Additional data to support this projection come from a survey done by Gallup for ATA. This type of survey has been conducted periodically for the past 19 years. The latest survey, conducted in 1981, indicates that 2/3 of the population of the United States have traveled on an airplane once in their lifetime, compared with 1/3 in 1962. Thus there has been a significant penetration of the potential passenger pool. Also, market growth rates of travelers will be tempered on the negative side by such things as reduction in population growth rates, inflation, economic downturn, interest rates, impact of fuel costs on fares, and the potential effect of telecommunications on travel - although this last topic is by no means clear at the moment. On the positive side there is an increase in disposable per capita income, which should stimulate additional travel. Taken together, all of these factors would seem to substantiate the slow but steady growth rate as projected by the ATA long range forecasts.

Returning to the Gallup survey and examining the population pyramids and how they track with time, i.e. how the frequency of travel varies with age group, some interesting observations arise. Consider the post-war "baby boom" group, which received encouragement to fly in the 1960's with all types of family, youth and student discounts. Apparently these tactics were successful in motivating these individuals to fly, since the percentage of the age 35 and under group which responded affirmatively to the question, "Have you flown within the past year?", increased from 14 percent in 1962 to 22 percent in 1970. But since 1970 this percentage has remained stable, and is now actually beginning to decline. The figure was 24 percent in 1980. Looking at other population age groups responding to the same question: the 35-55 group increased from 11 percent in 1962 to 27 percent which represents a plateau which has remained essentially constant for the past 7-8 years; similarly for the age group greater than 55, where the corresponding figures are 12 percent in 1962 and a 26 percent plateau.

All of these factors tend to support the concept of a mature market, and, in fact, the notion of double digit growth rates reappearing and persisting for any extended periods of time is not compatible with the slowing trend in population growth. Starting with the large base of air travelers which already exists, a sustained double digit growth rate would imply that in 30-40 years most of the people in the country would spend most of their time just flying around in aircraft.

Nature of Industry

Within the bounds set by these forecasts as to the size of the future market, one of the major questions affecting the issue of aircraft/airport compatibility is the nature of the service industry. Will it develop along the lines of a few carriers operating a limited number of aircraft of large size at low frequencies, or, at the other extreme, a large

number of carriers operating a large number of smaller aircraft at high frequency? This is a real crystal ball type of issue, but based upon evaluating the considered opinions of a large number of sources, it is not surprising that the most probable answer lies somewhere in between. Just where is difficult to say, but it seems reasonably safe to predict that the system which evolves over the years will be quite dynamic in nature.

It appears that the trend among established carriers is to continue the hub and spoke, feeder and connecting format. These carriers see this mode as their major strength, and so those airports which are currently connecting hubs for major carriers are going to continue in that role. The new carriers which have recently appeared primarily as point-to-point operators, offering low fare service in high density markets with no interline agreements and very streamlined operations, will continue to come and go and will probably grow in number with time. The commuter carriers are picking up on the routes abandoned by the major carriers, as the latter make every effort to match their routes to their equipment so that it can be operated profitably. Both the commuters and the new point-to-point carriers are being selective in their new markets to assure that they do match well with their equipment.

Aircraft Utilization

Aircraft utilization has undergone a reversal in the past decade, and will most likely reverse again in the next decade. In the late 1950's and the 1960's the airlines had acquired new fleets of jet aircraft, and were saddled with tremendous fixed costs in having to pay for them. Thus, the objective was to use the aircraft as much as possible to generate revenue, since marginal operating costs for an additional segment or two, which might be added to a daily aircraft schedule, were relatively small. However, when the price of fuel jumped from 11.7¢ per gallon in 1972 to well over $1.00 per gallon today, the economics were completely changed. Whereas in the first case the extra segments could usually generate profit with a load factor of 20-30 percent, now over 50 percent load factors are required, and the airlines cannot afford to operate the aircraft over any but the very best segments. Thus, where the system was once driven by the desire to spread fixed costs over the largest possible route system, it is now driven by fuel costs, implying conservation and reduction of marginal stages.

However, the pendulum is about to swing again. Although the cost of fuel, now stable, will probably resume its rise in the future, it is not expected to be catastrophic, but rather tied very closely to the general rate of inflation. On the other hand, in order to obtain quieter and more fuel efficient aircraft, the airlines are about to embark into an era where they will have committed tremendous fixed costs to fleet replacement. This has already started with the DC 9-80. The B-767 will start operating in 1982, the B-757 in 1983, the B-737-300 in 1984, and some new 150 seat aircraft will undoubtedly become available in the later 1980's. Thus, fixed costs will again dominate the system, and more emphasis on utilization can be expected once again.

Some perspective on the extent of the fixed cost problem is provided by the ATA study published a few years ago. It was called "90 by 90", because it predicted that the capital needs of the air transportation industry would be $90 billion by 1990. Re-examining this position in terms of present developments, it still appears to be a valid estimate. Although the numbers, costs, and mixes of the aircraft have changed somewhat, it still adds up to about $90 billion by 1990.

Expected System Changes

This discussion will now focus on the system changes and the types of aircraft and fleet which will impact the airports in the future, and what the compatibility issues will be. Unfortunately, but in agreement with the previous presentation, the answer is that it is impossible to generalize. Each situation must be considered on a case-by-case, airport-by-airport, and airline-by-airline basis. It is impossible to make generalized statements about aircraft and their impacts. Thus it is necessary to develop specific forecasts for each airport under consideration. These forecasts involve such items as past passenger enplanements, future growth potential of the airport, trends in the share of traffic for the individual airport relative to the total U.S., the various social and economic variables for the local area (e.g. population, per capita income, employment, etc.). Using these factors, the percent share of the total market is forecast, and when multiplied by the total U.S. industry enplanements forecast, the projections of future enplanements at the airport are obtained.

This number is not related to the number of carriers serving that airport. To illustrate, the number of carriers at Phoenix recently increased from 7 to 16 in 1-1/2 years. Yet, in spite of the fact that Phoenix looks good from the point of view of many of the factors mentioned above, the number of enplanements declined 6.4 percent during 1980. This is relative to an 8.2 percent national decline. Thus, based on its good indicators, and as might be expected, Phoenix did better than the national average, but it is clear that the number of enplanements were not influenced by the number of airlines operating there. What did occur was a sharing of the market, with the incumbent carriers losing 16 percent of their previous business to the 9 newcomers. The number of enplanements has continued to decrease, dropping another 2.8 percent during the first six months of 1981, which is in line with the nation as a whole.

The real issue arising from these statistics is to identify the proper impact of the large increase in the number of carriers. It was not an increase in passengers, but rather a focus on the ability to accommodate the carriers properly. This emphasizes the fact that it is absolutely essential that terminal facilities be designed with flexibility and adaptability; with designs being functional and efficient for both the terminal and apron facilities, with both being able to accommodate the dynamic changes which will surely occur with time.

Returning to the general case, after forecasting the specific growth at each airport, the next question is to translate this into aircraft movements. This again involves specificity with regard to existing aircraft equipment, load factors, and fleet mix, and the impact this will have on the airport. Looking at the"design day", i.e. the average day in the peak month, and the "design hour" (the peak hour of the design day), terms generally used in the analysis of facilities, one can determine current utilization of existing facilities and develop the scope and sizing of future facility requirements.

The "design day" forecasted enplanements are divided by the projected load factor to obtain available seats. From this, the mix and number of aircraft movements can be determined to accommodate the available seats. This is accomplished by taking into account the historical mix of aircraft which provides the average number of seats per aircraft movement for each aircraft size category and the total "design day". Then, looking into the future, the retirement schedules for the various types of the existing older

aircraft, the plans for replacing this equipment with larger, quieter aircraft, along with higher seating densities are all taken into account in determining the increase in the average seats per aircraft movement and total number of movements for each forecast period for both the "design day" and "design hour".

Studies have shown that the trend over the past few years, which incidently has been unaffected by deregulation, has been for a steady increase in average seats per aircraft movement of 2 - 4 per year. This appears to be a reliable figure to use as a reasonability check when forecasting the future fleet mix by equipment type and size categories for an airport. This future equipment mix is the primary indicator of any future compatibility problems that may be encountered for both the airfield and apron/terminal area.

There are impacts in a wide variety of areas. On the airfield side, overall aspects such as peak hour operations and capacity are of concern, as are the physical layout and lengths of runways, taxiway widths, separation distances, fillets, etc. Impact of extended wings and stretched fuselages on the existing runways, taxiways and hold areas, and their impact on the apron and gate areas must be determined. In the terminal, the impact of increased passengers on various functional areas such as ticket counters, bag claim, departure lounge, etc. are the important considerations to analyze.

Future Aircraft

Present indications are that in the 1980's, the aircraft mix will shift primarily toward a replacement of current aircraft with equipment of larger capacities. For example, the DC-8's, B-707's, B-737's, B-727-100's, smaller DC-9's, older B-727-200's, etc. will be replaced with new vehicles such as the B-767 and A-310 in the 200 seat range; the B-757 in the 175 seat range; and the B-737-300, A-320, proposed MDF-100, and perhaps a new Boeing plane for the 150 seat market. Although the DC-10, L-1011 and the B-747 will continue slowly to come on-line, the larger aircraft will not be the dominating factor in considering impacts on the airports. The predominance of the various new smaller aircraft in the 150-200 seat size category will be the major factor, along with the entry of the newer carriers who will be purchasing and flying some of the older equipment sold by the more established carriers.

The situation will be different at the major international gateway airports. Here the concern is primarily with the larger aircraft, including the B-747, DC-10, and L-1011. McDonnell Douglas is considering a stretched DC-10 for those markets which will not support the B-747. In addition, Boeing has also indicated some possible changes to its 747. For example, Swissair has already ordered a 200 inch upper deck stretch which will add an additional 32 passengers. This involves no other basic dimentional changes. However, a stretched body version, adding 31 feet to give an overall length of 263 feet, is also under consideration, as is a full double deck model of the existing B-747 aircraft. The stretched body version would increase passengers in a two-class operation to 565-600 passengers. The full double deck may run as high as 700 passengers. This latter aircraft will require a new wing which will increase span from 190 feet to 240-250 feet. This may well have an impact on airport compatibility, particularly with regard to various separation standards, fillets, etc. In addition, since the outboard engine will be out a little farther, runway and taxiway shoulder stabilization requirements may have to change. There will probably be an impact on gates; and it may be necessary to handle these aircraft with remote parking and transporters. The additional "slug" load of passengers at the various service areas (i.e. ticket counters, departure lounges, bag claim, etc.) in the terminal may necessitate some changes in accomodating these passengers.

Also on the stretched B-747, the struts of the main gear and nose gear will have to be lengthened three feet because of the rotation requirements during take-off. This will raise the sill height from 16 feet to 19 feet, which may cause difficulties with existing passenger loading bridges. If the double decked version is used, it will require access from a third level in the terminal, or the use of interior stairs to feed the upper level. Trade-off studies have been underway on this question, and it appears that the use of interior stairs will be selected. Emergency evacuation from the upper level may also cause some problems.

While it appears likely that one or both of these versions will arrive on the scene within the time frame covered by this conference, the key questions are how many aircraft, and how many airports will be affected? The list would seem to be limited to about nine in the United States: J. F.Kennedy, Honolulu, Miami, O'Hare, San Francisco, Dallas-Ft. Worth, Atlanta, Seattle, Los Angeles, and maybe Anchorage as a fuel stop.

Returning to the smaller aircraft, the B-767 will have a wing span of about 156 feet. While this is some ten feet longer than that on the B-707 and DC-8 aircraft it will replace, it is basically the same diminsions of the standard DC-10 or L-1011. It appears as though some trade-off has already been made in the B-767 design to accommodate airport compatibility. Initial studies indicated that the best wing span from the point of view of fuel economy would have been 176 feet, but as noted above this has already been reduced at the request of the airlines in their desire to fit this aircraft into the existing airport gate areas without too much disruption.

The current DC-9 has a wing span of 94 feet, and the B-727 of 108 feet, while the new B-757 will have a 125 feet span, and the MDF-100 will have a 113 feet span. Thus there will be increases of some 15 to 30 feet in wing span for this class of aircraft. Again, the situation will have to be examined on a case-by-case basis, emphasizing the previous theme of flexibility, incremental expandability, adaptability, functionality and efficiency of terminals to accommodate a changing fleet mix of aircraft.

It is helpful when airport operators are willing to be flexible and change basic terminal concepts developed before deregulation, in order to more efficiently accommodate today's requirements. For example, when American Airlines significantly increased its service at Dallas/Ft. Worth and made this station a major connecting complex, the airport was willing and able to switch its curvilinear "walk-to-gate" concept to a modified pier-finger complex to accommodate American's needs in a new terminal unit - and it had the flexibility to do so.

Another example of recent planning regarding the layout of the apron-gate area is the new midfield terminal at Atlanta. Considerable effort went into the determination of the separation between the individual terminals A, B, C, and D. It was finally decided that there would be nose-in parking with dual-line bypass taxiway capability, and the design aircraft would be the standard DC-10 or L-1011, and not stretched versions or the B-747. However, about 40 feet extra leeway was included, which will allow for some small variation in wing size, perhaps for the accommodation of winglets or a small stretch.

Important in making this basic decision were the trade-offs between the extra cost required to further increase the separation distance between the terminals. This includes such items as apron size, apron maintenance, taxiing distance, size of the people mover system, and the fact that the B-747 size aircraft was designed to be handled at the international terminal complex, and also could be accommodated at the ends of the other four terminals, if required at some future time. Thus, good economy was achieved while still preserving the concept of flexibility for possible future developments.

There are two areas of current concern to the airline industry regarding the airfield and apron area. Recently, heavy emphasis has been placed by both FAA and ICAO on providing for runway safety areas at all existing, as well as new runways. In planning for new runways at existing and new airports this makes lots of sense and is strongly encouraged. However, in retrofitting at existing airports the situation must be analyzed on a case-by-case basis. It certainly does not seem prudent to shorten runways just to improve the safety areas. It is hoped that the runway safety area standards can be interpreted with a sense of judgment on an airport-by-airport basis as they apply to existing runways.

Another area of concern involves a recent move by ICAO to establish a standard relating to providing an emergency evacuation capability from an aircraft on the ramp if it is being fueled with people on board. This requires that a large amount of space on the ramp be kept clear in the vicinity of all the aircraft emergency exit doors. Since the ramp already is a busy and congested place during periods of aircraft servicing, this new requirement is bound to seriously impede servicing, increase turnaround times, and be expensive to the airlines. The reasoning behind this decision is not clear. there has been fueling of aircraft with people on board all over the world for decades and, there has never been a serious accident resulting in loss of life. Therefore, why is it now necessary to alter the process? One of the dangers of such regulations is that they tend to be expanded and liberally interpreted by zealous individuals at the sites involved, and before long it may be dictated that crash-fire-rescue trucks must stand by at each such refueling. This example is cited as an illustration of the fact that all aspects of a problem need to be examined carefully before forging ahead with hastily contrived regulations.

Conclusions

This paper has pointed out several issues relative to the air transportation system changes which may occur in the future, and their impact on aircraft/airport compatibility has been identified. By and large they are matters of common sense. The conclusions reached are the following:

(1) System changes affecting aircraft/airport compatibility will be slow and evolutionary over time and not the quantum evolutionary type of change experienced with the advent of commercial jet aircraft in the late 1950's, and the introduction of the large B-747 in the late 1960's.

(2) The compatibility issues cannot be generalized. They must be considered on a case-by-case, airport-by-airport and airline-by-airline basis.

(3) Forecasts show that the growth of future U.S. industry passenger enplanements will exhibit the characteristics of a mature market.

(4) Future air transportation system changes will require airports to be flexible, functional, efficient, and incrementally expandable. These features must be applicable in all directions and involve all activities; e.g., one of the most critical problems today is the lack of outbound baggage makeup space at a large number of airports.

(5) Future aircraft will be quieter, which will be environmentally helpful to airports.

(6) On a case-by-case basis, the whole area of airport capacity must be examined. It is important that quotas or other forms of limitations be avoided, particularly in the key hub and connect-complex airports. Every effort must be made to allow the marketplace to take care of itself.

(7) Large aircraft (i.e. stretched B-747's) in the future will only be used in the gateway airports in international service. These aircraft will not be used in domestic service in this century.