A Look into the Future of Airport Planning, Design, and Construction by Analyzing Current Issues

WILLIAM FIFE, *Frederic R. Harris Inc.*
MICHAEL T. MCNERNEY, *University of Texas at Austin*

As we look toward a new millennium in air transportation, we must also look at the past and the present. Future market forces that are impossible to predict will radically change the growth of the aviation industry, which is less than a century old. In order to analyze the aircraft of the future and the airports that will be compatible with these aircraft, one should look also at what the industry sees as the emerging issues. This paper provides a summary overview of the current issues that have been identified by the aviation community in the areas of airport planning, design, and construction. The process used to identify these major issues was outlined and discussed during the proceedings of the American Society of Civil Engineers (ASCE) International Air Transportation Conference in Austin, Texas, in 1998 (*1*).

Discussions began at the ASCE International Air Transportation Conference in Louisville in June 1996, with a number of senior-level engineers, planners, and architects considering the major issues they are and will be facing in the planning, design, and construction of domestic and international airports. These discussions focused on the need to better identify these issues and engage in further dialogue regarding their implications for planned and ongoing airport development programs. Issues needed to be considered not only from a planning perspective, but also from a design and construction viewpoint. Issues identification began immediately after the June 1996 conference and has resulted in input from more than 40 groups, including design and planning firms, architects, engineers, aircraft manufacturers, and airport operators.

INDUSTRY TRENDS

To put the emerging issues into proper context, many began their discussions with a review of the fundamental trends that are now being faced in the airport and aviation industry. These key trends are outlined below:

- Changes in the airline industry, including route structures and airline hubbing;
- Continuing growth in the airline passenger and air cargo markets;
- Government downsizing and increased focus on public-private partnerships; and
- Growth in the global economy and a changing worldwide political environment.

In considering these trends, it is clear that airports must be able to maintain a flexible response to the dynamics of an industry in which rapidly changing technology and political and economic events often affect and reshape all aspects of airport operations.

KEY ISSUES

The issues outlined in this paper are only a brief summary of the whole array of issues facing airports. Some of these areas of concern are continuing as well as emerging, but continuing in a new form (such as ticketless travel within the overall area of new technology).

The process used to identify the specific issues outlined in the following discussion involved the development of a matrix that listed issues by source. Those issues that appeared most frequently in each respondent's top 10 list became those that were highlighted in this paper. As the survey results were tabulated over the past 3 years, it became clear that the four top issues were capacity and delay, new aircraft, environmental concerns, and technology.

These four top issues are outlined along with some of the key subtopics or problem areas that were identified during the survey process.

Capacity and Delay

With airports around the world experiencing higher and higher levels of delay, it was no surprise that the issue of capacity and delay was at the top of almost every list. With many industry analysts predicting a more than doubling of passenger traffic in the next 10 to 15 years, the current delay problem will only worsen. To deal with these capacity and delay issues, additional public and private investment will be required. Among the concerns mentioned in this area are the following.

When will the transition to the future National Airspace System (NAS) be made and who will be paying the bills? The 1926 Air Commerce Act directed the Secretary of Commerce to develop lighted airways to let pilots see their route of flight at night. Now we have a nationwide system of airways using navigation aids nearly as obsolete. The new NAS using advanced technology is promised for the future, but how will it affect the airports and aircraft?

What are the implications of flight delays at one airport that affect airlines and passengers nationwide? Denver International Airport is a great example of how building a new airport to reduce delay in one city could result in reduced delays systemwide. As the NAS becomes still more complex, the interaction of delay and congestion at one airport can influence the entire system.

There are serious concerns about Federal Aviation Administration (FAA) staffing and outdated equipment. The federal agency that regulates and controls aircraft movements and airport access has changed many times in the last 75 years. There have been discussions of significant impending changes that will occur several times in the next century. How will those changes affect the configuration and regulation of airports in the future?

What are the implications of the changing fleet mix and new technology, such as the Global Positioning System (GPS)? What will the future aircraft fleet mix be at our commercial service airports? Will super-jumbo aircraft be landing in large numbers? Will we have growth in small aircraft made possible by advances in aircraft technology and large-scale production? Will a technology breakthrough eliminate the wake vortex problems that

keep the spacing of landing and departing aircraft far apart? Advances in precision guided-instrument approaches are on the immediate horizon with differential GPS and precision runway monitoring (PRM). These new advances will provide near-term reductions in the delay situation.

New Aircraft
The single most important issue concerning aircraft and airport compatibility is concern about the introduction of new super-jumbo aircraft. The introduction of jet passenger aircraft into U.S. commercial service in 1958 created a critical need for longer runways at major U.S. airports. In 1970 the introduction of the wide-bodied Boeing 747 created the need for another major revision to airport infrastructure to accommodate aircraft that carried over 400 passengers and had a wing span of nearly 60 meters. However, looking into the crystal ball is difficult. Will the New Large Aircraft (NLA) proposed by Airbus and Boeing, which could have a wing span over 80 meters and carry over 600 passengers, really be built in large quantities? Unfortunately, it is not a decision that someone can make today. The technology exists, but the development cost is very high. Only the market forces of the next 10 years will determine if the NLA will be built in large numbers. The global economy and the constraints to the system imposed by competition among airlines, takeoff and landing congestion, and airline operating costs will determine if the proposed NLA will make business sense.

In most of the aviation industry responses, this issue began as a concern for the implications of the introduction of the NLA, but it quickly grew into a discussion of fleet mix diversity and the effect of new-generation aircraft on all sizes of airports. The new aircraft cover the full spectrum from regional jets to narrow-body twins to the planned NLA. Each of these new aircraft types will present different challenges to airport planners, operators, and airlines.

Key points highlighted in this area included the following:

- *The need for new FAA and International Civil Aeronautics Organization (ICAO) standards for new versus existing airfields:* It is much easier to apply standards for very large aircraft to new airports than to existing airports. Increasing the distances between runways is cost prohibitive on most of the landlocked major airports in the United States.
- *The importance of initiating planning for these aircraft now, not when they are about to enter service:* Fortunately, it takes several years to build, test, and certify a new aircraft. Unfortunately, it takes even longer in most locales worldwide to decide on, plan, design, and build a new runway.
- *Wake turbulence and in-trail separation issues:* The larger the gross weight of an aircraft, the greater the wake turbulence the aircraft produces at the same speed. If a super-heavy aircraft were to be built, it has not been determined what the safe following distance for lighter aircraft would be. A potential increase in the in-trail separation might wipe out potential capacity gains of a very large aircraft in certain aircraft fleet mixes.
- *Aircraft-runway interaction issues:* The larger and heavier aircraft will respond to long-wavelength pavement unevenness, which was never a safety issue in the past. This increased aircraft response will dynamically load both the pavement and the aircraft structure, landing gear, and antiskid braking system. The results may increase the threat to the nation's infrastructure as well as affect the safety of aircraft operations. There is a need

to define the existing runway environment and a need for FAA and ICAO to set criteria that limit pavement unevenness.

- *Opportunities for improved taxiway guidance and flight deck management systems to reduce aircraft separation requirements:* Improvements in cockpit technology could permit pilotless commercial service aircraft. However, hardly anyone believes that the traveling public would accept that service in the near future. Nevertheless, the technology will certainly permit reductions in the safe separation distances of aircraft from each other in the air and on the ground. Will the results of implementing this new technology be a tremendous burden on airports or will they lead to savings?

Environmental Concerns

Almost all respondents focused on environmental issues. The increased emphasis on the environment in all areas of society is also evidenced in the aviation arena. For many years, the major focus in the environmental area for airports was noise. Now a full range of environmental issues is now on the plate of almost every airport manager. In fact, often the environmental concerns and necessary remediation may be the determining factor in whether facilities can affordably be built. Considering that the majority of the regulations of the National Environmental Policy Act of 1969 (NEPA) have only been in place for 30 years, what will the next 30 or 50 years bring?

Environmental regulation and preservation of the environment could have the biggest impact on airports and aircraft in the future, and could threaten the national aviation system as we think of it today. However, by the same token, new technology may develop alternative measures that decrease the reliance on fossil fuels.

In the responses of the aviation professionals, the following major points were covered:

- *Soil remediation and technical approaches:* How clean is clean? How does an airport recover the cost for cleanup of the soil?
- *Added time to deal with environmental processes and issues:* Thirty years' worth of NEPA regulations that have been added piecemeal, with different interpretations for different standard industrial codes, has resulted in a lengthy process for dealing with the regulations. Will the environmental compliance process become so lengthy that new construction is strangled to a point where the system can never catch up in adding capacity to airports? Airports have always managed to be flexible in constructing facilities in short times in an attempt to satisfy airline demand. That flexibility will be reduced because of the lengthy environmental compliance process.
- *Air quality issues:* The air transportation industry is a small contributor to air pollution emissions relative to other transportation emissions and industrial emissions in large metropolitan areas. However, the airport is a likely target for government-mandated mitigation. Alternative-fuel ground vehicles will become standard fixtures in most airports in large metropolitan areas. However, much research is needed in this area in both analysis techniques and remediation techniques.
- *Energy conservation:* The airports of the future will work toward sustainable resources. There is a great need to develop better energy-saving lights and better waste management practices that recycle renewable resources. Airports will develop energy strategic plans as frequently and in the same manner as they do in the master planning process in use today.

Technology
All aspects of the aviation industry are being affected by the introduction of new technologies. These changes are occurring more quickly than ever before, yet the process for dealing with this changed environment seems to be taking longer. It was clear from the input in this area that there is a real need to be more proactive with technology. Airports can't wait but must anticipate the introduction of new technology. A need identified by this committee is that airports provide funding for research and development. In the future, airports will join to fund research to improve the design, construction, and maintenance of airport facilities.

The items mentioned under the area of new technology included the following:

- *New security equipment:* The high cost of new explosive-detection equipment (CTX 5000) is a large burden for many airports. How should airports plan for funding and where would they locate the equipment?
- *Ticketless travel:* What are the implications of electronic tickets and Internet purchases? Will there be a reduced need for ticket counters? Will the ease of ticketing actually help to increase ticket sales?
- *Security concerns:* The longer the security process is perceived to take, the earlier passengers will arrive at the airport. This in turn creates higher demand for hold room space at the gates. A policy that requires positive bag match at large hub airports would be devastating to the critical aircraft turnaround time in current hubbing operations.
- *Intelligent Transportation Systems (ITS):* How will this technology affect airport access and landside design and operations? What is the relationship of ITS to parking lot operations and design? There will be an increase in the use of highway advisory radio or other advanced traveler information systems.
- *Differential Global Positioning System (DGPS):* The implementation of DGPS for aircraft ground and air navigation is a foregone conclusion for the near future. DGPS will be used to reduce noise impacts and noise mitigation costs, as well as to reduce delays and increase capacity.

Use of Information on Issues
The information gathered during the issue identification process has been widely disseminated in the airport and airline industry. This information has been used by some airports as a checklist to validate ongoing strategies and master planning efforts.

One of the major uses of the information has been by the Airport Peer Review Group. Every few months, the Peer Review Group meets for a day and a half to brainstorm and share ideas about current and future airport projects. Consisting of airport managers, FAA staff, directors of airport planning and engineering, and program and project managers for airport reconstruction efforts, the Peer Review Group is a powerful catalyst for innovation in airport development and operation.

The group began meeting over 9 years ago and proved so valuable to its members that its scope grew from just the northeastern United States to include most of the major airports in the United States and Canada. Meeting at a different airport each time, the group focuses in the first-day session on recently completed or upcoming major projects at the host airport. After a briefing on the projects, the group members give their input on the initiatives.

The second day of each session is devoted to information sharing on various topics suggested by the peer group members. Members learn how other airports are handling similar problems or issues. Past agendas have included topics such as security, environmental remediation, retail planning, new technology like the GPS, and project management approaches. It is during the second day of the sessions that emerging issues have been discussed. Many of these topics have become almost a fixed part of the agenda because of their relevance to airport planning.

CONCLUSION

The areas outlined contain a compilation of issues and ideas from many of the best thinkers, planners, and managers in the aviation industry. This paper did not attempt to provide answers or solutions but instead identified a full range of topics that need to be thoughtfully addressed by the airport and aviation community. The issues identified in this paper offer the airport community both challenges and opportunities. They will need to be addressed both collectively and independently since many are interrelated.

REFERENCE

1. Fife, W. Current and Emerging Issues in Airport Planning, Design, and Construction. In *Airport Facilities: Innovations for the Next Century* (M. T. McNerney, ed.), 25th International Air Transportation Conference, ASCE, Reston, Va., June 1998, pp. 1–5.