Statement
of

RICHARD R. JOHN
Director

JOHN A. VOLPE NATIONAL TRANSPORTATION SYSTEMS CENTER

Research and Special Programs Administration
U.S. Department of Transportation

on the

ADVANCED AUTOMATION SYSTEM BENEFIT-COST STUDY

Before the Subcommittee on Transportation
Committee on Appropriations
U.S. House of Representatives

April 19, 1993

Mr. Chairman and Members of the Sub-committee:

I am pleased to testify today on the recent Volpe Center study of the FAA's modernization of the hardware and software at the heart of the nation's Air Traffic Control (ATC) system, a program known as the Advanced Automation System, or AAS. This Committee's Report accompanying last year's Department of Transportation appropriation bill directed that a comprehensive benefit-cost study be performed on the individual segments of this program by the Volpe Center. In my testimony today, I will describe the conclusions of the study, which was initiated this past November and is now being documented.

BACKGROUND

Three different types of Federal Aviation Administration facilities are involved in controlling air traffic. Airport towers manage aircraft on the airport runways during takeoff and landing and in the airspace out to about five miles from the airport. Terminal area control facilities have responsibility for aircraft approaching and leaving airports for a distance extending from about five miles out to about 60 miles from the airport. Finally, in the regions between airports and their surrounding terminal areas, planes are under the control of Enroute Centers in the continental U.S. Air traffic controllers at each of these facilities are thus able to monitor and control aircraft throughout their flights, assigning routes, maintaining safe

separation, and sequencing them into their destination airports. A force of over 9,000 maintenance personnel is required to keep the system operating, about 20% of whom maintain the traffic control automation system elements.

At the heart of this complex system are the computers and communications that take in radar and other data, process it, and display it on console screens. These screens are the window through which the controller receives most of the information needed to assure the safe and efficient movement of traffic through the region of his or her responsibility.

Much of the system is quite old, with the result that maintenance requirements and costs are increasing rapidly. The system is inflexible, and overall functionality is limited by the computer and display technology, much of which was installed in the 1970's and embodies technology dating from the 1950's and 1960's. The 1200 controller consoles at the 20 enroute centers now experience approximately 12,000 failures of components every year -- an average of one failure every five weeks for each unit.

The Federal Aviation Administration's basic vision for the upgrade of the Airport/Airway System is twofold. First, new computer hardware, display equipment and operating software will replace existing components. This will create a basic automation foundation -- often referred to as a "platform" -- based on the newest technologies. Second, with this platform in place, the entire air traffic control process can be re-engineered, based on

new methods and software tools now being created in the FAA research and development program. These changes will greatly advance the ability of controllers to manage traffic in a more flexible and efficient manner, with benefits to FAA, carriers, and passengers.

This modernization represents an important conceptual change. The situation is analogous to replacing a single-function word processing system, such as were common in the 1970's, with a powerful 1993 version of the personal computer, operating on a local area network and linked to the world by data lines. You may still use the system for word processing, but, as time passes and your needs evolve and become more complex, it is readily applied to new uses simply through installation of new software. Further, just as personal computers are now built so that the user can easily upgrade by installing new and more powerful microprocessor chips, the Advanced Automation System hardware and software elements are being developed in modular form to facilitate growth and take advantage of future improvements where needed.

Whenever computers and other new technologies are introduced into the workplace, it is not assured that the full benefits potentially available will be obtained immediately. Effective use of automated tools and information technology requires re-engineering the entire process, and often the whole enterprise. Many of the people involved will find that new systems change the way they work and even the nature of their jobs. Development of revised

procedures and training, and gaining controller confidence and acceptance will be critical to implementation.

The advanced automation program includes several major segments. The first automation phase has been focused on the enroute centers. As part of this effort, the communications equipment that connects those centers with external systems, such as radars, has nearly been completed. Current emphasis is on replacement of the controllers' aging display monitor and other tools with a color-display workstation which is in itself a powerful computer capable of working in a distributed-processing mode. This is a particularly critical segment of the advanced automation program, since it will be the basis for subsequent system hardware and software expansions. This workstation is the heart of what IBM is currently developing for FAA.

The next program segment will be the upgrade of terminal area facilities by replacing the main computer and displays used for controlling approaching and departing aircraft. This segment will include installation of controller workstations similar to those in the enroute centers, but also includes replacement of the terminal area facility's primary computer system.

Moving next to the airports, comprehensive integrated display systems will be provided for tower controllers, and the interface to the terminal area facilities will be upgraded.

The final stage of the advanced automation program is replacement of the existing mainframe computers at the enroute centers, along with the over-20-year-old software designed for their predecessors, and linking of the enroute and terminal systems into a distributed computing facility.

COST-BENEFIT METHODOLOGY

Costs. Our approach to the cost/benefit study included a detailed analysis of projected costs of both the current and new automation systems, based on data from a variety of sources. Although it is not considered feasible to continue operation of the existing system through the year 2020, it was used in the study as a baseline for comparison purposes. The baseline costs for the existing automation elements were determined from such sources as enroute, terminal area and airport facility lists, Federal Aviation Administration spare parts schedules, staffing standards and maintenance histories. The time period considered was 1993 through 2020, based on a nominal 25-year expected lifetime for new equipment.

Maintenance costs for the baseline case were projected on the basis of the best existing model and data for aging electronic and electromechanical systems, as obtained from the Department of Defense. The largest uncertainty and most critical consideration pertained to the assumed rate of maintenance cost growth for those components past the end of their design life, since little data is available for air traffic control equipment operated

beyond its nominal lifespan of 25 years. The information that does exist suggests that an annual growth of 5% to 10% in maintenance cost is a conservative expectation. A 10% growth implies a doubling every 7 years and quadrupling in 14 years; ultimately it is not sustainable.

A detailed analysis was also conducted to estimate the costs of the improved automation system, broken down by segment for four alternative program scenarios, including both capital investment and hardware and software maintenance. Construction of new facilities, telecommunications costs, and expenses for personnel relocation were also included.

In projecting future total costs for each of the different automation segments, estimates were made of development, facility, equipment and transition costs.

Benefits. In our study we assessed benefits from two perspectives: the provider and the user of air traffic services.

The providers are the FAA's Airway Facilities and Air Traffic organizations. The quantitative Airway Facilities benefits were estimated by comparing the costs, determined as I just described, for each automation segment through the year 2020 with the costs of that segment over the same time period if no changes were made. The study also considered improvement of air traffic controller productivity.

The users include the air carriers, with consideration of general aviation, and air passengers. Benefits for the air carriers and general aviation included estimates of the reduction of enroute operating time and enroute, terminal area and airport delays. Benefits for the passengers were also estimated based on time savings.

Another beneficiary, outside the scope of the study, is the Department of Defense, which is planning to use the platform provided by the terminal elements of the automation program as the basis for its future radar approach control facilities.

FINDINGS

System Providers

FAA Airway Facilities Organization. The total cost for continued operation of the baseline system through the year 2020 is projected to approach $10 billion. The cost for implementation and subsequent maintenance of the new automation system through 2020 is about the same, within the uncertainties of discount rates and the growth rate to be expected for maintenance costs in years beyond the design life of the system elements. Although the new system, being software intensive, will have higher software maintenance costs, equipment maintenance should be far lower than for the baseline, and stable, rather than increasing rapidly with time. There is a

strong, though unquantifiable potential for significant savings in training and maintenance logistics as a result of standardization of system components.

Far more important, however, is the potential for reliability problems in the existing system increasing to the point that system operations are seriously affected, accompanied by increasing practical inefficiencies and diminished productivity throughout the organization. Indeed, even if its operational constraints could be tolerated, it is unlikely that the present system could be supported through the 2020 timeframe.

FAA Air Traffic Organization. We believe that controller productivity may increase significantly, but verification and quantification of this result must await availability of the new platform, the first of which will be installed in Seattle in October, 1996. Current research will also shed light on this subject.

Potentially-important benefits are also anticipated in terms of controller training, due to standardized improved methods and tools; increased confidence in system reliability; and reduced operational stress associated with the availability of more accurate and timely airspace information and better tools for controlling and managing traffic.

More generally, advanced automation will allow a much more effective and flexible response to changing future requirements, including effects of the

next generation of aircraft and possible changes in patterns of airport and airway utilization.

System Users

Air Carriers. The introduction of new automation in the terminal area will make it possible to introduce new application software and control procedures to better sequence the incoming traffic flow and potentially reduce time loss due to delays by 7% or 8%, based on current traffic projections. This is also the subject of an ongoing research and development activity.

The introduction of new automation into the enroute centers provides the potential to increase enroute capacity through restructuring of airspace and improved operational flexibility. This is a significant benefit in those situations in which enroute capacity is a limiting factor.

The full planned conversion of the enroute centers will provide the possibility of introducing new air traffic control procedures that will permit the air carrier to operate with preferred routes and altitudes and thereby reduce flight times and operating costs. As part of our study we examined over 11,000 actual flights occurring over a 3-day time period. We found that cumulative flight time and operating costs could be reduced by approximately 2% overall, or an annual savings to the airline industry of $200 million in fuel alone, and additional substantial savings in crew costs. Virtually all of

these benefits accrue to flights of 500 miles and longer. Achieving this result also requires successful completion of a research and development program and effective implementation of its findings.

All of this translates into important potential benefits for air carriers in terms of fuel savings and reduced crew time. In addition, aircraft utilization may be improved significantly. To the degree that preferred routes and reduced delays yield shorter scheduled flight times, airlines will be able to increase aircraft flights per day, potentially reducing fleet requirements.

General aviation in particular will benefit from the improved information controllers are able to provide concerning weather, resulting from more complete integration of weather information into the automation system.

Air Passenger. The time savings to the passenger resulting from improved automation are only a few minutes per flight. This is a relatively small improvement in flight time, and is likely to be insignificant to most passengers when compared to their total trip time. The major benefit for the airline passenger is improved adherence to flight arrival schedules due to the introduction of better methods and tools to respond to weather and other special circumstances.

In summary, the study showed that all segments of the AAS system are cost-effective. Benefits for the providers and users arise to a large degree from different elements of the program. The operating cost savings experienced by carriers and reduced delays for passengers are associated primarily with improvements at the 20 enroute centers and a small number of terminal area facilities in high traffic density locations. On the other hand, the reduced maintenance costs that represent the principal quantifiable provider benefit arise mainly from modernization of the many towers and low-density terminal area facilities, since they are the location of the great majority of ATC equipment.

CLOSING REMARKS

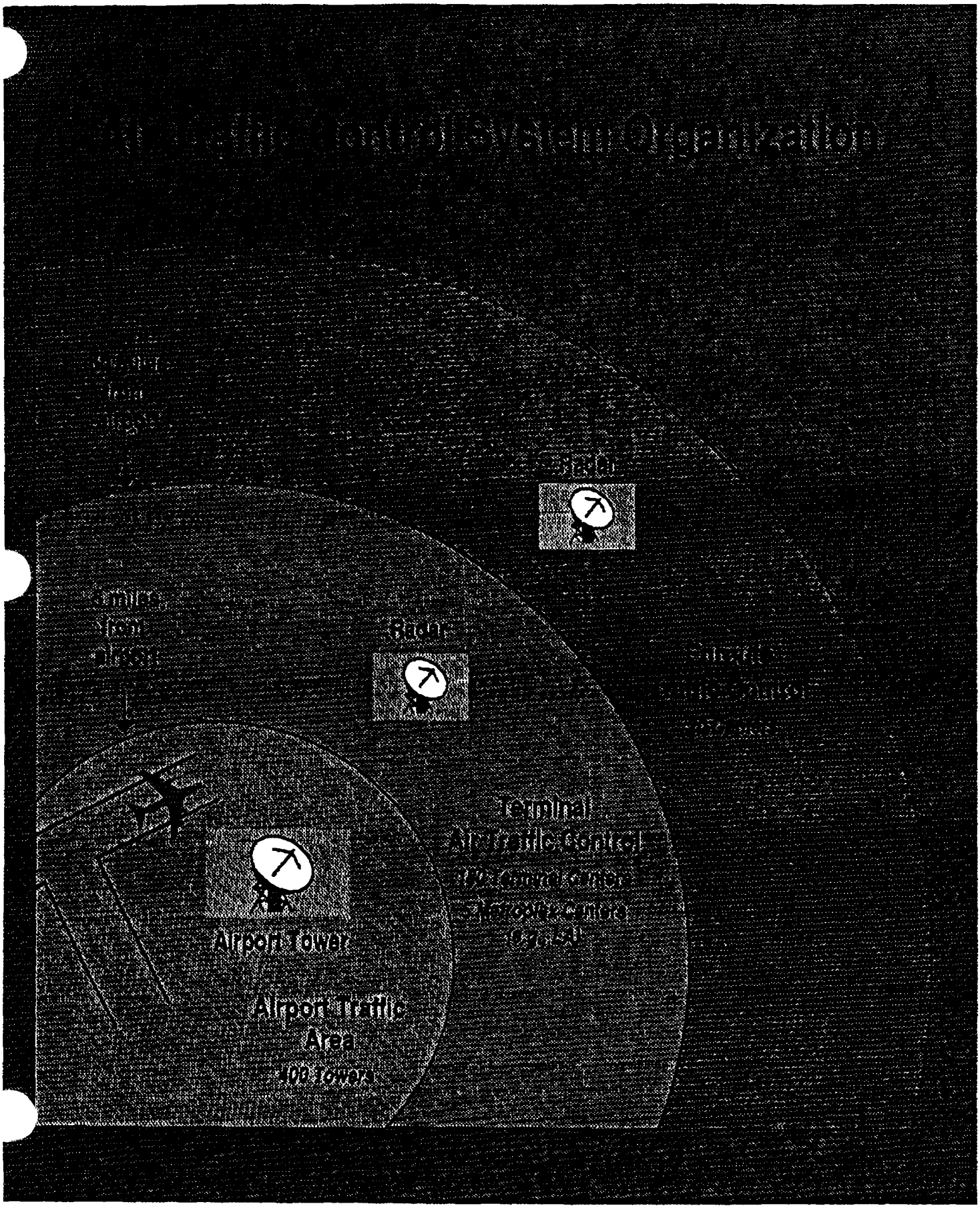
The system modernization embodied in the advanced automation program is more than renewal of obsolescent technologies. It replaces equipment dedicated to specific functions with much more powerful computer platforms capable of supporting a wide range of new applications, some as yet not envisioned. It will provide the foundation for re-engineering the entire air traffic control enterprise, resulting in a robust and flexible technological base with which to meet the known and unknown challenges of 21st century aviation.

No program of this scope and ambition is free of risk. The technical challenges are large, and our ability to devise and gain acceptability for new

tools and procedures may fall short. The most important benefits cannot be quantified. However, the risk of trying instead to patch together the existing system for the study period clearly carries the far greater risk of a limping Air Traffic Control System subject to ever larger and more damaging disruptions.

One last point. The global market for air traffic control systems is growing at a rate of 10% annually. Currently about $7 billion per year, the ATC market is expected to reach more than $14 billion by 2002. It is already a fiercely competitive business, particularly since it is dominated by firms seeking to broaden their non-defense work. The capabilities, credibility and competitiveness of American firms in this arena will be strongly affected by the degree to which the United States Air Traffic Control System reflects technical leadership and demonstrates the benefits of advanced technology.

I am pleased to answer any questions you may have on this study.


Radar
Terminal
Air Traffic Control
Airport Tower
Airport Traffic
Area