Chapter 1

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The U.S. aerospace industry and the U.S. Government have conducted research over the past two decades to develop advanced-technology supersonic, as well as subsonic, commercial air transports. Since the initiation of the U.S. Supersonic Transport (SST) program in the early 1960's, Congress has repeatedly debated the desirability of, and the appropriate level for, Federal funding of research and development (R&D) directly relevant to civil aircraft applications.

The appropriateness of Federal involvement in the development of a civil supersonic air transport has been at the heart of those debates. Although funding for supersonic technology development and certain other areas of aviation research with civil applications was virtually eliminated in the Federal budget for fiscal year 1982, it continues to be addressed in Federal budget planning and evaluation.

A major concern for Congress in evaluating past and proposed Federal investments in R&D relevant to commercial aerospace has been whether aerospace firms can translate the results of Government-assisted research into viable commercial aircraft programs, Because of the expected high costs and high risks of producing advanced-technology air transports, it is uncertain whether and how U.S. aircraft manufacturers could produce them. Future decisions by Congress about funding civil aerospace R&D will depend on how the financial capacity of the aerospace industry is perceived.

This background paper provides perspective on the implementation of advanced air transport programs by examining such issues as associated risks, industrial organization, and financing capacity. It addresses the business and financial aspects of developing and producing advanced air transports. It then outlines alternative approaches to managing and financing advanced air transport programs, including alternative ways for the Government to encourage and assist such programs, if desired. The technological challenges and expectations for advanced air transports have been described in the master report of this OTA project, *Impact of Advanced Air Transport Technology, Part 1: Advanced High-Speed Aircraft.*

BACKGROUND

Advanced air transports would differ significantly from subsonic and supersonic aircraft in use today. An advanced supersonic transport (AST) would offer superior speed, passenger capacity, noise suppression, fuel efficency, and overall performance compared with current supersonic transports (the British-French Concorde and the Soviet TU-144). It would require structural materials, manufacturing processes, propulsion systems, and controls different from those of subsonic counterparts.

An advanced subsonic transport (ASUBT) would differ from contemporary subsonic transports by incorporating new structural materials, manufacturing processes, and propulsion systems, plus improved aerodynamics and controls. It would offer substantially better fuel economy (perhaps 30 percent better per seat-mile) than a contemporary wide-body jet. Differences between ASTs, ASUBTs, and their predecessors would affect virtually all aspects of their development and production programs,

Aircraft programs comprise several stages. The first involves generic or basic R&D, which explores and validates basic design and technology concepts. Generic R&D is much less expensive than the next stage, specific R&D, in which specific product concepts are developed, and the third stage, tooling and other preparation for production. Specific R&D is the most expensive stage, involving the fabrication of prototypes and repeated testing of designs and prototypes over several years.[1]

During the specific R&D stage, manufacturers consult with potential airline customers on desired design and performance characteristics, develop specifications, and seek orders for proposed planes. After a design and set of specifications are selected, facilities and production tooling are ordered in preparation for production. The cost of production tooling for conventional aircraft programs has been one-third to one-half that of (specific) development costs.[2]

Revenues typically begin to flow through progress payments when orders are placed, followed by additional progress payments and payment of the balance on delivery, although in some cases airlines lease new aircraft from the manufacturers. As figure 1 shows, new aircraft programs become very costly in their early stages, as spending increases sharply during the first few years.

Industry experts believe that an advanced supersonic air transport program could cost up to $6 billion to $11 billion (1980 dollars) over a 10- to 15-year period. By contrast, recent programs for transports using contemporary subsonic technology cost about $2.5 billion, including $1.5 billion for the airframe plus up to another $1 billion for the engine (current dollars, through the 1970's).[3] The actual magnitude of initial investment necessary depends on many factors—such as the size of the aircraft, initial order levels and production rates, inflation and productivity, mode of financing, and the timing and extent of design changes.

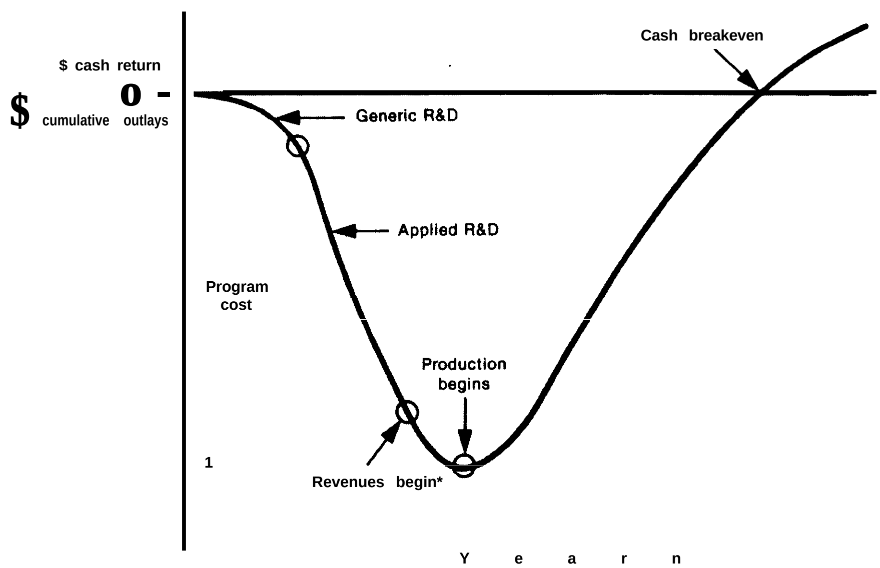
The investment would go primarily for specific R&D and preproduction expenses. Some generic R&D has already been conducted under the sponsorship of the National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD), beginning with the U.S. SST program and subsequently through such programs as the NASA Supersonic Cruise Research and

[1] Harman L. Butler, Jr., et al., "The Aerospace Industry Re-Revisited, " in *Financial Analysts Journal,* July-August 1977.

[2] Butler, op. cit.

[3] See, for example, "Aerospace Industry Survey: Basic Analysis, " prepared by Robert Spremulli for Standard & Poor's, Apr. 3, 1980; and reports in trade and business journals,

Figure 1.—Cumulative Cash Flow Curve for Commercial Air Transport Program



*Advance payments commence prior to production

SOURCE Herbert T Spiro and John R Summerfield, "Finance and Program Alternatives for Advanced Air Transport Vehicle Program, contract report prepared for the Off Ice of Technology Assessment, October 1979

Variable Cycle Engine programs. Research since the SST was canceled has substantially improved several technologies, but additional research and substantial development efforts would be necessary for either an AST or an ASUBT program.[4]

Although industry analysts expect that advanced air transports, and in particular ASTs, would be more expensive to produce than conventional aircraft, it is impossible to be sure of a cost differential at this time, several years prior to planning for specific advanced air transport projects. Relatively high costs for advanced air transports, especially for ASTs, would stem in part from the use of new manufacturing processes, plant, and equipment. Using new production technologies involves additional startup costs.

[4]Domenic J. Maglieri and Samuel M. Dollyhigh, "We Have Just Begun To Create Efficient Transport Aircraft," in *Aeronautics & Astronautics*, February 1982.

On the other hand, progress in aircraft manufacturing technologies, including adoption and refinement of computer-aided design and manufacturing systems and other productivity-enhancing developments, would tend to offset cost increases associated with advanced air transport technologies. Although industry analysts have been concerned about declining productivity in the aerospace industry over the past few years, growth in the capabilities and use of computerized automation during the 1980's could improve aerospace industry productivity and lower the costs of undertaking an advanced air transport program. '

'See, for example, U.S. Department of Commerce, U S. *Industrial Outlook 1981*, 1981.