inclusion in new aircraft designs typifies the careful approach the manufacturers are taking today. In addition to rigorous technical verifications, involving in-flight demonstrations, considerable attention is being paid to the relationship of the fuel cost savings to the cost of the development.

Examination of how this development cost can be incorporated in the price of the engine and ultimately the aircraft involves evaluating sales, timing of demand, competitive responses and financial analyses from both the manufacturers' and the airlines' viewpoints.

It is clear that no matter how certain it is that the ultra-high bypass engine is technologically feasible, the ultimate criterion for its successful entry into commercial service will be whether it clears the economic hurdles for both manufacturer and airline.

Conclusion

During the short life of the aircraft manufacturing industry spectacular advances in efficiency, reliability and maintenance costs have been achieved. Attempts to pass the cost of development on to the customer all too frequently were not entirely successful, and it is evident the same pressures that caused this have been exacerbated by deregulation.

Today the pressure is on costs, and the need to carefully think through business decisions is mandatory. Very little room for error remains. The continuation of a successful industry requires, more than ever, prudent evaluation of technological improvement, determination of its acceptance and value to the airlines, and how it relates to the cost of development.

HELICOPTER INDUSTRY

David S. Lawrence, Sikorsky Aircraft

The helicopter session had an excellent cross section of the industry, including manufacturers, diverse operators, consultants, and government agencies. The discussions were issue oriented and addressed the present, the next five years, and the following five years in each of five broad areas:

- market conditions
- exogenous competition
- industry structure
- technology
- infrastructure.

The session concluded that

- Traditional markets are slowing down as growth rates in the using sectors (e.g., offshore oil) level off
- Growth will remain strong in business applications as helicopter sophistication and reliability improve
- Technology thrusts will concentrate on improving the conventional helicopter, particularly its economics and dispatch reliability.
- The critical threat to helicopter industry growth is the continued constraint of its infrastructure, principally the shortage of heliports and dedicated airways.

Market Conditions

The market for helicopters and helicopter services was segmented into six submarkets:

- offshore
- business and corporate users
- commuters
- intercity commuters
- public service and emergency medical service (EMS)
- miscellaneous less well-defined users.

Offshore Oil - Historically the largest revenue market and core of the industry's growth, this segment weakened significantly when oil exploration and development activity fell off dramatically in response to declining demand for oil and shortages of cash in the oil industry. The domestic offshore service business was projected to remain flat or to decline further from its present level of about 600 helicopters, and the session could not identify a turnaround. However, aircraft are leaving this segment at a rate of 6 percent per year through attrition or replacement; hence the entry of aircraft into the market will outpace the slow growth of seat-miles. These aircraft will come from the large reserve fleet of surplus and underutilized offshore service aircraft, because the present overcapacity will preclude significant sales of new equipment. A major new Alaskan discovery could create an activity boom, but one of short duration that would utilize excess equipment from elsewhere in the world.

The international market was seen to be a bit brighter, and it was projected that finds of affordable oil (i.e., oil of high quality and low finding costs) in the Middle East and Asia would provide a new market for helicopters. These are likely to be new equipment, since a substantial number of the surplus helicopters are leased under terms that preclude long-term operations outside of the United States. The consensus was that there would be modest growth internationally, perhaps 7 to 8 percent per year in seat-miles, barring any destabilizing political events.

Corporate Helicopters - It was estimated that business helicopter activity had tripled during the last five years, driven largely by the popularity of the intermediate twin engine types. This trend is not reflected in sales of new aircraft and is apparently masked by the influx of used equipment into this sector but fixed base operator and charter services are clearly growing rapidly. Nonetheless, sales of new business helicopters have fared better than business turboprops, of which they are a subset, increasing the helicopter share of that market from 3 percent in 1979 to about 9 percent in 1984. It was projected that the diminishing importance of used aircraft as they are assimilated into the fleet, and resolution of the uncertainty surrounding federal tax laws, would accelerate sales of new business helicopters, which might approach 12 to 15 percent of the business turboprop market in the next five years.

There was general agreement that the business helicopter market was not particularly price

sensitive, and that growth of this sector would depend on improvements in the following areas, in the order listed:

1. time savings
2. convenience
3. dispatch reliability
4. cost.

There was some difference of opinion on the meaning of the present contraction of in-house helicopter flight operations. A number of large corporations have reduced their fleets in favor of charter services, and there was no consensus as to whether this tendency was a phenomenon of the business cycle or a new way of doing business, perhaps in response to the stronger spotlight in which corporate practices generally are being scrutinized. In either case, one positive result has been a more cost-effective approach to business helicopter operations, which could benefit both the sales and use of this equipment in the long run.

Commuters - The present generation of helicopter commuters, essentially limited to routes between airports and city centers, is seen as complementary to fixed-wing air carriers and competitive with alternative surface modes. Like business helicopters, this market is believed to be relatively price inelastic, although fares are in fact heavily subsidized by trunk air carriers who see the helicopter as an essential link in their long-haul system. The commuters' rationale is their protection of the value of time saved in the air carrier system by (predominantly) business travelers; to ensure this protection helicopter commuters fly as many as 40 percent extra sections in the course of normal operations. The strongest market for helicopter commuters is at non-hub airports where trunk carriers compete for passengers and the helicopter ride becomes a factor in long-haul ticket sales. Nonetheless, it was felt that the business community's value of time was such that the better positioned helicopter commuters could survive even without the de facto subsidy of interline fare agreements.

A strong latent demand seems evidenced by growing surface congestion and more difficult airport access in the fastest growing United States cities. Recent studies have in fact identified 25 likely markets for helicopter commuters on the basis of air carrier origins and destinations, surface transportation alternatives, and passenger demographics. It was thought that the only constraint on growth in this sector was the lack of suitable urban heliports.

Intercity Commuters - This market is seen as an extension of both corporate helicopters and intercity commuters. Its rationale is that the fixed-wing system has never been able to solve the problem of surface congestion at both ends of a trip, and that on short stage lengths the time savings of high speed between airports is offset by that congestion. This is clearly the niche for short-haul intercity helicopters operating directly from city-center heliports. It is this solution, generically, that underlies the rapid growth of the business helicopter market as well, but corporations (as opposed to scheduled carriers) can internalize their travelers' cost of time. The economics of corporate helicopters are not as impressive as scheduled intercity carriers with three times the load factors, but the general public thus far has been unable mentally to offset increased cost against saved time in intercity travel.

There was a consensus that profitable intercity helicopter operations with appropriate flight equipment would require that some outside agency or public body subsidize the development and other nonrecurring cost of that equipment, as the French and British governments did in the case of the Concorde, and for many of the same reasons. None of the session participants felt that this would happen during our ten-year time frame; thus the strength of demand, the market size, and the economic threshold for the intercity helicopter concept are likely to remain untested in the foreseeable future.

Public Service - Discussed under this umbrella were emergency medical services of the air-ambulance type and interhospital air transfers, which may be operated privately or publicly, and public services normally operated by the public sector, including police, fire, and civil defense activities. The availability of heliports is not usually a constraint in the public service market, but the source of funds for helicopter acquisition and operation is not clear. In contrast with other societies where health and hospital care is more formally socialized, it is difficult in the United States to find a single agency that bears both the costs and benefits of emergency medical services (EMS) and thus can justify the extensive use of air ambulances. Government studies have demonstrated the cost-effectiveness of both medical evacuation and hospital transfer by helicopter, but long-term growth of this market will be paced by the ability of the air-medical industry to communicate that information to the general public. The medevac mission as such does tend to be undertaken by the public itself, and a major issue in the growth of this activity is the overlap between private and public operation of the helicopters. The growing availability of used or underused military equipment, operated by government agencies at real or booked charter rates that do not reflect actual operating costs, has tended to depress private-sector willingness to provide such services. There was substantial concern that this tendency would limit private-sector investment in EMS to levels below those necessary for long-term improvement in its economics and technology. While public-sector participation in public-service helicopter missions might be valid in cases where private-sector services are not feasible (and might even stimulate business in such cases), continued public-sector participation at present levels is likely to discourage the private interest needed for long-term growth.

The forecast for this sector thus is a modest one. The spurt of hospital funding in 1983-1984 has leveled off, and annual growth in the sector, now estimated to use 100 helicopters in the United States, was projected to average 5 to 6 percent over the next ten years.

Miscellaneous Users - Helicopter missions considered in this category include power line work, electronic news gathering, external lifting, and miscellaneous utility work. Taken together these constitute a significant share of present and future helicopter activity. There was consensus on two issues. First, this sector is particularly income and price elastic; it thus expands and contracts with the economy, and is not a major market for new equipment. Second, as it grows in parallel with the expanding economy, it will be a growing and significant factor in air traffic control.

Exogenous Competition

The threat to helicopter growth from alternative modes of transportation and communication was not considered to be severe.

Fast rail was thought to be not feasible during the first five years, but it may be a potential competitor for intercity commuters during the following five. The issue of fast rail versus intercity helicopters was not expected to emerge during the next decade.

Teleconferencing was felt to compete with air transport very little, and with helicopter transport not at all.

Short-haul Short take-off or landing aircraft (STOL) should not be a factor in the near term. The only short-haul STOL projected to have significance in the actual downtown-to-downtown environment was the tilt-rotor, itself a rotorcraft, which is not likely to be in air carrier service during the ten-year forecast period.

Business Turboprops in the corporate market were seen as an opportunity rather than a threat. Helicopter penetration of this market should exceed 12 percent during the forecast time frame if not constrained by technology or infrastructure.

Industry Structure

The session forecast a subtle restructuring of the manufacturing side of the industry -- not a reduction in the number of players, but a re-organization of interests -- as a result of an increase in joint ventures, coproduction, and other manifestations of the globalization of the industry. Intercompany teaming on the JVX and LHX programs will profoundly affect industry structure; the ultimate impact on the market will be a reduction in the number of choices available, but, more importantly, a concomitant reduction in the product cost as a result of worldwide economies of scale in technological as well as manufacturing development.

On the helicopter operating side, the number of large fleets (ten or more aircraft) will decrease over the forecast period; but the availability of used equipment and the low cost of entry will lead to a proliferation of small helicopter operators, particularly during peaks in the business cycle. These forces portend a flattening of charter rates, an increase in traffic, reductions of scale economies and profit margins, and a marked increase in the aircraft service business to which the smaller operators will turn for maintenance. Competition among charter operators was expected to be further tightened by the entry into Part 135 operations of corporate aviation departments seeking to amortize their costs.

Technology

Other than quantum changes, such as tilt-rotors, X-wings, and perhaps LHX-derived systems, none of which are expected to be in commercial service in the next decade, the outlook suggests a plateauing of traditional helicopter technology. However, three technical thrusts will piggyback on this decade's military advances: avionics, flight control systems, and pilot procedures. These three will significantly reduce real estate requirements as well as noise exposure in urban centers and thus will provide a strong impetus for growth. There was some concern, however, that delays in the approval of these system advances might be a constraint.

In general, it was forecast that the thrust of new aircraft technology would be directed toward reduced operating costs, principally in the areas of maintenance, fuel consumption, and dispatch reliability.

In an important footnote to the technology issue, it was considered likely that the major helicopter manufacturers, heeding the economic lessons of the 1970s, would not again attempt to develop dedicated, point-design civil helicopters and that future civil helicopters will be limited to derivatives of high-production military equipment.

Infrastructure

Aside from some segments of the offshore oil and utility lift businesses, the demand for helicopters and helicopter services is driven by surface congestion, and it will continue to grow as surface congestion grows. The most serious constraint on growth now is that helicopters are still compelled to work in a fixed-wing system. When they are operated as airplanes instead of as helicopters they tend to lose their special utility; since that special utility carries a price tag, the choice of vertical lift is constrained by artificial economic considerations.

The core of this problem is the general lack of off-airport heliports and helistops. While acknowledging the acceleration of Federal Aviation Administration interest and investment in this problem, near-term assistance in a broad develop- of visual flight rules (VFR) heliports is essential.

Another aspect of infrastructural constraint is disunity in the government as well as the operating community on the issue of discrete helicopter airways. The competition for airspace is keen, and it has disproportionately constrained helicopter activity, as compared to fixed-wing, because of a general lack of helicopter orientation in the regulatory community and its resultant difficulty to optimally separating fixed-wing and helicopter operations. The National Airspace System Plan (NASP), specifically, has built-in constraints that will hold back efficient joint use of airspace by rotary- and fixed-wing aircraft. And provides no improvements in NAVAIDS for low level flight -- below line of sight -- i.e. for helicopters. Rotary winged aircraft are forced to operate under rules designed for fixed-wing aircraft. And the anomaly is that only by efficiently separating fixed- and rotary-wing equipment can they effectively work together in the national transportation system. There was a feeling among participants in the session that continued growth in the helicopter industry would require that the federal government nuture it the way it has the fixed-wing industry in the past, and that such a policy would be very much to the benefit of the general public.

There will be increasing local resistance to large community heliports, increasing complexity of heliport applications, and increasing noise and environmental constraints, mirroring the problems faced by the fixed-wing industry. However, smaller heliports and helistops are expected to grow to meet demand.

It was felt that the helicopter industry had to explain itself better to the public, not only on safety and noise issues, but also on the value of helicopters to the community and its business.

Other Issues That Affect Growth

Surplus aircraft The equivalent of perhaps 1,000 aircraft -- 10 percent of the active fleet -- is not now working. The extent of the problem may be hidden, because many of these aircraft are being held in inventory rather than put up for sale, where they might alert creditors to an operator's fragility.

Military aircraft Projected deliveries of 1,000 military aircraft in the next five years will affect the airspace problem and may displace a significant number of older aircraft to the already slow used aircraft market.

Insurance costs Third-party liability awards have quadrupled in the last ten years, and insurance premiums on helicopters are now prohibitive. It was felt that these costs do not fairly reflect helicopter performance, and that they are inequitably allocated.

Human resources A growing shortage of skilled maintenance technicians will affect direct operating costs and helicopter reliability as the aircraft and their maintenance requirements become more sophisticated. There is a parallel need to upgrade standards for pilots.

The driving issue is still the need to integrate helicopters into the national transportation system in a way that will allow them to contribute to the system by fully utilizing the unique efficiencies of vertical lift. As one member of the helicopter session put it, "How many more miles of concrete runway do we have to build to accommodate the inadequacies of horizontal flight, and how much longer will we have to operate our vertical flight equipment in this outmoded fixed-wing system?"

BUSINESS AVIATION

James S. Arthur, Sperry Corporation

This session discussed current and future trends in business aviation and areas of needed future research. Several aspects of the problem were examined, including present conditions, trends, legislation and regulation that affect the industry and future technology.

In summary, it was concluded that business aviation continues to play an important part in our national transportation system, and except for its most visible segment, new aircraft production, the industry is doing quite well.

Current Situation

There is evidence of some improvement in the current situation within the business aviation industry. Studies indicate that total fleet hours and average aircraft utilization are both up over the past two or three years, yet neither figure has yet gotten back to the historical highs of 1979 and 1980.

Both fixed-base operators and overhaul centers are reporting increased levels of business. They are selling more fuel and performing more maintenance and repair work for operators. However, new aircraft shipments, a very visible measure of the health of the industry, remain low. This is a critical factor to the industry.

There are several reasons for this situation. One of the most important factors affecting the sale of new aircraft is the large supply of good, low-time, late-model aircraft currently available on the market. Many of these aircraft were built between 1979 and 1981, are in excellent condition, and are priced at less than one-half the cost of a corresponding new model. In many cases the new and used airplanes are identical, and the new aircraft salesman finds that he is competing aginst a low-priced version of his own product.

Second, many of the traditional end markets for new business aircraft have dried up in recent years. Certain business segments, such as natural resources, agriculture, and the traditional smokestack industries, do not now have the available discretionary income needed to invest in aircraft.

Finally, the true acquisition cost of new aircraft is at an all-time high. The combination of pricing, interest rates, insurance, current tax rates, and expectations of future inflation rates make this a less than desirable time to invest in a new aircraft. In addition, the possibility of a pending tax reform has caused many potential customers to delay their purchase decision until the entire tax matter has been resolved.

Economic Outlook

In order to develop a picture of trends within the industry it is necessary to define the anticipated economic scenario. The group adopted the scenario presented by many of the major forecasting firms. This is a picture of moderate economic growth, an inflation rate of 4 to 6 percent, slowly falling oil prices, slow improvement in corporate profits, and an orderly decline of the dollar on world markets. Furthermore, it was assumed that there will be no major protectionist restraints or significant net tax reform measures that would affect business aviation. Also, there will not be any meaningful improvements in markets critical to business aircraft, namely natural resources, agriculture, or the traditional smokestack industries.

Changing Industry Structure

The structure of business aviation has been changing very rapidly. There have been more mergers of aviation-related companies than ever before, eliminating the independents. Just recently General Dynamics acquired Cessna; Ryder Systems purchased Aviall, an overhaul facility; and Allied Corporation and the Signal Companies have merged. There is evidence indicating that this trend is far from over and that further consolidation of airframe manufacturers, suppliers, overhaul and maintenance centers, as well as operators can be expected.

While operators of business aircraft will not merge in the traditional sense, many will pool their resources in new ways. More creative leasing arrangements and alternate methods of both ownership and utilization of business aircraft will be developed. Two forms of aircraft pooling are becoming popular. The first is the charter networks that are being established among independent charter operators to give customers a "one phone call" approach to arranging their flights. The second form of pooling is another type of charter service. Several companies that own and operate business aircraft, and would normally operate under a FAR Part 91 certificate have found that they have excess capacity within their fleets. Rather than eliminate or waste this excess capacity, these