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The Perception of Travel Agents as to Passenger Acceptance of the High Speed Civil Transport in Commercial Airline Service: A Study of Tomorrow's Transpacific Air Travel

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PASSENGER ACCEPTANCE OF THE HIGH SPEED CIVIL TRANSPORT
IN COMMERCIAL AIRLINE SERVICE: A STUDY OF TOMORROW'S
TRANS PACIFIC AIR TRAVEL

by

James H. Starnes, III

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This thesis was prepared under the direction of the candidate's thesis committee chairman, Dr. Charles Richardson, Department of Aeronautical Science, and has been approved by the members of his thesis committee. It was submitted to the Office of Graduate Programs and was accepted in partial fulfillment of the requirements for the degree of Master of Aeronautical Science.

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Abstract

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Through a cooperative effort between NASA, Boeing Commercial Airplane Group, Douglas Aircraft Company, GE Aircraft Engines, and Pratt & Whitney, technology for a new-generation supersonic transport aircraft is being developed. To determine if air travelers will choose this aircraft, the High Speed Civil Transport (HSCT), as their mode of air transportation on transpacific routes, a self-developed questionnaire was sent to randomly selected travel agents in the Los Angeles, California area. The questionnaire examined criteria that passengers use to select transpacific flights, including fare, schedule, flight time length, and comfort. Results indicated that all passengers will be attracted to supersonic air service because of the reduction in travel time. Business and wealthy leisure passengers will be willing to pay a fare surcharge of up to 30% over subsonic fares for supersonic service. Price-conscious leisure passengers will only use supersonic transportation if the cost is the same as competing subsonic service.
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Introduction

Through a cooperative effort between NASA, Boeing Commercial Airplane Group, Douglas Aircraft Company, GE Aircraft Engines, and Pratt & Whitney, technology for a new generation of commercial supersonic transport aircraft is being developed. This new aircraft, called the High Speed Civil Transport (HSCT), will be capable of carrying 300 passengers over routes between 4,500 miles and 6,500 miles in length at speeds between Mach 1.8 and 2.4. The HSCT is scheduled to fly as early as the year 2005, and will greatly reduce the travel time from the United States to Asia and the South Pacific. The long, overwater routes across the Pacific Ocean are well suited to the HSCT for both economic and operational reasons. Economically, air travel demand across the Pacific is expected to grow at a rate of 8.8% annually through the year 2002. This growth will cause an increase in the number of transpacific flights needed. Since a sonic boom will be created by the HSCT while it is flying at supersonic speeds, it is likely that the aircraft will be limited to subsonic speeds while over land. Because of this operational restriction, maximum utilization of the HSCT will only be achieved by operating the aircraft on long, overwater routes like those between the United States, Asia, and the South Pacific.

Although the HSCT will be very fast and will have long-range capabilities, it will be very expensive to purchase, and may also be costly to operate and to maintain. A question that is of paramount importance to aircraft designers, manufacturers, and operators is whether enough passengers will choose this supersonic aircraft for their travel needs over existing subsonic service to make HSCT operations profitable. In order for airline managers to formulate economic guidelines to be used to evaluate potential supersonic service, the managers need to know how many passengers will potentially use the new aircraft for their travel needs, and how large a fare surcharge they can impose. In order to create an aircraft that is acceptable to the airlines, aircraft designers must first determine the economic criteria that the airlines will use to decide whether to buy the
new aircraft. To determine if it will be profitable to produce the HSCT, manufacturers must know the maximum purchase price and operating costs that airlines will accept, and how many aircraft the airlines are expected to order. Since airlines today primarily use Boeing 747 and McDonnell Douglas MD-11 aircraft on transpacific routes, Boeing and McDonnell Douglas are interested in knowing if the production of a supersonic aircraft would severely reduce demand for future derivatives of the Boeing 747, Boeing 777, and McDonnell Douglas MD-11. By examining the criteria passengers use to select long-distance air transportation, it will be possible to estimate the success of a new generation of supersonic aircraft.

Statement of the Problem

The purpose of this study is to determine if business and leisure airline passengers originating in the United States will choose the High Speed Civil Transport (HSCT) as their mode of air transportation over subsonic transports, such as the Boeing 747 and McDonnell Douglas MD-11, that operate on the same routes. For the purposes of this study, the HSCT is a next-generation supersonic commercial transport that is being designed to fly 300 passengers a distance of 4,500 to 6,500 miles at cruising speeds of Mach 1.8 to Mach 2.4. This new aircraft will be used primarily on overwater routes between the United States, Asia, and Europe.

Review of Related Literature

Before examining the HSCT in closer detail, it will be informative to review the air travel market growth brought about by faster aircraft throughout this century. Historically, as advancements in powerplant and airframe technology improved commercial aircraft speed, passengers' acceptance of the new service grew, and demand for air travel increased. Airline passengers in the 1940s had grown accustomed to aircraft such as the Douglas DC-4 and DC-6 that could travel at speeds just over 200
knots using piston engines. Soon, the Douglas DC-7 and Lockheed Electra provided
service with turboprop engines at speeds approaching 350 knots. Although there were
increased acquisition and operational costs associated with the new aircraft, airlines
found it unnecessary to increase fares. According to Brenner (1986), the improvements
in technology that brought about faster speeds actually decreased costs on a seat mile
basis. This reduction in cost occurred because the newer aircraft were capable of
carrying more passengers than their predecessors, thus providing more seats over which
to distribute the costs.

The next major advancement in commercial aircraft technology occurred in the
late 1950s when jet aircraft, such as the Boeing 707 and the Douglas DC-8, entered
service. These new, jet-engine-equipped planes were even more expensive to purchase
and to operate than planes equipped with turboprop engines. Again, large fare increases
were not needed to compensate for the additional cost of providing jet service, due to
capacity and productivity increases brought about by the increased size and speed of jet
aircraft. Soon, airline passengers accepted the jet aircraft because of their speed,
comfort, and quietness. Travelers quickly became accustomed to flying across the
country in only five hours, and across the Atlantic Ocean in only eight hours.

The last major technological advancement that increased the speed of commercial
air travel came in the early 1970s, when the Anglo-French Concorde was introduced.
This aircraft is capable of cruising at speeds of approximately twice the speed of sound,
and can fly the heavily traveled New York to London and New York to Paris routes in
only three and one half hours. As with previous great advancements in commercial
aviation technology, the Concorde was extremely expensive to design and produce.
Unlike the turboprop- and jet-engine advancements of previous years, however, the
Concorde supersonic passenger aircraft was not a financial success. On a typical
transatlantic flight, the Concorde burns as much fuel as a Boeing 747, and has three times
the Boeing 747's maintenance cost, while carrying only one fourth of the number of
passengers (Taneja, 1989). Because the Concorde has so few seats over which to
distribute its large operational cost, Concorde fares are much higher than subsonic jet
fares. These expensive fares permit only travelers who are wealthy or who place a very
high value on their time to fly supersonically.

**HSCT development.** Nearly twenty years after the introduction of the Concorde,
the United States government and aircraft manufacturing industry are again considering
the design and construction of a new generation of supersonic passenger transport.
Because of the great amount of financial risk, long lead times, and large cost required to
develop the technology necessary for a supersonic aircraft, airframe and powerplant
manufacturers are reluctant to fund their own independent research and development
programs. A number of European companies have found that by forming consortia,
they are able to pool their resources and acquire enough funding for major research and
development projects. Airbus Industries, a consortium of several European aircraft
manufacturers, has become a major competitor to American aircraft manufacturers.
March (1990) states that Airbus Industries, which is aggressively trying to be the
technology leader in world aircraft production, is currently designing their own
commercial supersonic aircraft to replace the Concorde.

Loomis (1986) indicates that the United States is one of the countries in the world
that will most greatly benefit from the production of a supersonic civil transport. In an
effort to maintain the competitiveness of the United States, a cooperative effort to
develop and validate the necessary technology for the HSCT has been undertaken by
NASA, Boeing Commercial Airplane Group, Douglas Aircraft Company, GE Aircraft
Engines, and Pratt & Whitney. According to GE Aircraft Engines (1993), the first phase
of the cooperative effort, which began in 1990, involves developing airframe and
propulsion technologies necessary for the HSCT. The second phase, which began in
1993, involves testing component and system validity to determine if the newly
developed components can physically operate as designed, as well as meet the economic constraints placed upon them. The third and final phase of the HSCT development is scheduled to begin in 1997, and will include the construction of a flyable prototype and the creation of the final design specifications. According to Scott (1993), NASA has budgeted $187 million for high-speed transport research in fiscal year 1994.

Technological challenges. Before work could begin on developing the necessary technologies for the HSCT, NASA had to commission preliminary studies to determine the limits of modern technology. These preliminary studies also attempted to identify constraints and requirements that will be placed on a commercial supersonic transport by airlines, passengers, and society. The market potential of the HSCT, as well as preliminary payload, speed, and range characteristics of the aircraft were then determined.

Albers and Zuk (1988) report that there are several technological challenges that must be met if the HSCT is to become a commercially viable vehicle. The HSCT, which will cruise at altitudes over 50,000 feet, will fly well within the ozone layer found at altitudes between 48,000 feet and 140,000 feet. Since the ozone layer is environmentally delicate, it will be unacceptable for the HSCT to emit large amounts of ozone-depleting engine emissions. The preliminary studies revealed that there is no aircraft engine currently on the market that is capable of delivering the amount of thrust required by the HSCT without producing excessive pollution. Upon receiving this information, GE Aircraft Engines and Pratt & Whitney began work to design an engine that would satisfy both the thrust and pollution requirements. GE Aircraft Engines (1993) reports that it has developed concepts for engine combustors that will produce enough thrust without producing excessive amounts of nitrogen oxide pollutants that destroy the ozone layer. The engine manufacturers are confident that they will be able to transform these concept designs into operational powerplants for the HSCT.
Another important consideration in propulsion system design is the amount of noise pollution that the HSCT will create. Any new aircraft must meet the guidelines given by Federal Aviation Regulations (FAR) Part 36. These guidelines exist to protect the public from unacceptably high levels of noise pollution caused by aircraft during the takeoff and landing phases of flight. The FAA has recently amended Part 36 to require that all newly certified aircraft satisfy Stage III noise standards. To comply with the regulation, each new aircraft must meet takeoff, sideline, and approach noise limits (FAA, 1992). Since the Maximum Gross Takeoff Weight (MGTOW) of the HSCT has been estimated to be 750,000 pounds, it is possible to find the approximate Stage III noise limits that the HSCT must satisfy. Using equations provided by the FAA (1992), the takeoff noise limit is 105 Effective Perceived Noise Decibels (EPNdB), the sideline noise limit is 102 EPNdBs, and the approach noise limit is 106 EPNdBs. By comparison, a 870,000-pound MGTOW Boeing 747-400 with Pratt & Whitney PW 4056 engines produces 101.5 EPNdBs during takeoff, 99.7 EPNdBs on the sideline, and 104.7 EPNdBs during approach.

One technological challenge brought about by the Stage III noise requirement is that engines must produce sufficient thrust to accelerate the HSCT to supersonic speeds while remaining quiet enough during the takeoff and landing phases of flight. GE Aircraft Engines (1993) has conducted studies that show that it is possible to design engines that will supply the necessary thrust to reach supersonic speeds, while satisfying Stage III noise limitations. To satisfy noise requirements, however, it will also be necessary to use advanced light-weight, high-lift wing designs. Noise-abatement procedures, such as steep approach and departure routes, may also be required for the HSCT to satisfy Stage III noise standards.

Although designers are confident that the HSCT will be able to satisfy Stage III noise standards during takeoff and landing, the aircraft will still produce a sonic boom when flying at supersonic speeds. Morris, Winston, and Morris (1988) indicate that most
nations of the world do not allow commercial supersonic aircraft to overfly at supersonic
speeds because sonic booms cause a disturbance to the environment and to people on the
ground. Because of these restrictive considerations, the HSCT will be limited to
subsonic speeds while over land, and must be designed to operate efficiently at both
subsonic and supersonic speeds.

Airlines will be reluctant to use the HSCT on routes which are mostly over land,
because flying at subsonic speeds for long periods will not allow the aircraft to satisfy
productivity requirements necessary for profitability. For an airline with a route network
that is primarily over land, it will be unreasonable to purchase an aircraft capable of
flying at Mach 2.4, since its speed will be restricted to Mach 0.95 on most of the airline's
routes. One route that would be adversely affected by this speed restriction is the New
York to Tokyo route that is over land 88% of the time.

Travel demand forecasts. Since the HSCT's operational characteristics will make
it ideal for use on transpacific routes, it will be helpful to examine traffic forecasts for the
early 21st century to see if sufficient traffic will exist to support HSCT operations.
According to the FAA (1991), the Pacific region is the fastest growing international air
travel market for American air carriers. In 1990, transpacific traffic enjoyed its ninth
year of continuous growth, with passenger enplanements growing at an average annual
rate of 15.5%. Load factors in the Pacific region have remained high, even though the
number of available seats has increased 19.2% per year. In fact, an average load factor of
71.4% was recorded in 1990, which was the highest load factor ever for the Pacific

It is estimated by the FAA (1991) that there will be a total of 33 million
passengers carried across the Pacific Ocean by U.S. carriers in 2002, representing an
8.8% annual average growth in demand for transpacific air services. One reason such a
growth in travel demand is predicted is the continued economic growth of Pacific Rim
nations. The real Gross Domestic Product (GDP) in this region is expected to grow at a rate of 4.5% annually, indicating that businesses in this region are still expanding. This growth will have a positive effect on the air travel industry, since the need for air service grows as businesses expand.

Another factor responsible for the forecasted growth of the transpacific air travel market is the decline of the U.S. dollar compared to the Japanese yen. Since between 60% and 65% of the passengers traveling between the United States and Japan originate in Japan, the majority of the passengers on that route will find it cheaper to travel to the United States. The number of Asian passengers who decide to fly because of the reduced cost of an American vacation is projected to outnumber the American passengers who decide to stay at home because of increased travel expenses in Japan (FAA, 1991).

The traffic forecast produced by the Boeing Commercial Airplane Group (1989) is different from the FAA's, but it still suggests that there will be a growth of airline passengers in the world at an average rate of 5.3% annually through the year 2015. Boeing produced forecasts for the years 2000 and 2015 by assuming that individual markets in the world were maturing, and that they would grow by only 85% of the previous year's growth rate. Using their forecast, Boeing estimated that there is a potential of 315,000 daily HSCT passengers by 2000, increasing to 600,000 daily passengers by 2015. Boeing indicated, however, that this forecast was created by assuming that there would be no fare surcharge for supersonic service. If a fare surcharge is required, it is possible that the price elasticity of the market could greatly reduce the demand for HSCT service.

Operational characteristics. Vachal (1990) indicates that in order for the HSCT to be economically viable, it should have a range between 5,000 and 6,000 nautical miles, which would allow it to reach 90% of the intended supersonic markets. Longer routes, such as the 6,500 mile flight between Los Angeles and Sydney could be served using one-
stop service that would still be faster than subsonic nonstop service. At a design speed of Mach 2.4, flights between Los Angeles and Tokyo will take only four and one half hours, compared to 12 hours today. Even if the HSCT's operational costs are comparable to the costs of subsonic aircraft, designers feel that the HSCT must carry between 250 and 300 passengers for the aircraft to operate profitably. Since this is such a large number of passengers, it is felt that the HSCT should not only carry first class passengers, but business class and economy class passengers as well. Vachal indicates that due to operational and economical constraints, the HSCT would not be suited for routes less than 2,500 miles, or for routes with a daily demand of less than 300 passengers.

Primary service markets for the HSCT include routes from the United States to Europe and Asia. The HSCT will also be used on flights within the Pacific Rim, and on flights between Europe and South America. Hefner (1988) suggests that there will be 26 target cities with a combination of 98 city pairs making up the HSCT service market. Of these 26 cities, nine are in the Pacific region, including Mexico City, Los Angeles, Seattle, Honolulu, Sydney, Singapore, Manila, Hong Kong, and Tokyo. International Civil Aviation Organization (ICAO) (1986) data show that of the top 25 international airline passenger markets in the world, six would meet the HSCT's range and overwater requirements. These six markets include New York to London, Paris, Frankfurt, and Rome, as well as Tokyo to Honolulu and Los Angeles.

Airline considerations. It will be difficult for airlines to make the commitment today to order the HSCT when it becomes available. As The Aerospace Corporation (1978) shows, airlines work with manufacturers to satisfy projected fleet needs up to ten years in the future. The HSCT will not even be in the prototype stage until 2008, so airlines cannot conclusively say whether they will purchase this aircraft when it becomes available.
From an airline's point of view, the HSCT will be a very costly aircraft to purchase. Jacobson and Murphy (1988) report that aircraft price has replaced fuel price as the most important factor in airline operating costs, since aircraft price is more than twice as significant as the price of fuel. Because of the poor financial strength of several of the world's leading airlines, it is possible that only a few airlines will be able to afford the HSCT.

Van der Velden (1989) suggests that any new aircraft type that is acquired by an airline must fit on the airline's current route structure and allow expansion in existing markets. The more an airline's schedule is changed to meet the operational needs of the airplane, the more inconvenient the schedule becomes to the passenger, and demand for the service decreases. If the economic characteristics of the HSCT are such that airlines are required to fly the aircraft fourteen hours per day just to break even, then the aircraft will only be profitable for airlines that have route structures compatible with the HSCT's most efficient mode of operation. Most transpacific route structures will allow an airline to fly a Mach 2.4 aircraft 16 hours per day, while avoiding flights that leave or arrive between midnight and six in the morning. If an airline has a route structure that requires a flight to leave in the middle of the night to achieve the needed productivity, the airline may not break even on the route because of the reluctance of passengers to travel at such inconvenient times.

The HSCT must be either efficient enough or productive enough to reduce costs and increase revenues in order for airlines to consider its purchase. Rubin (1966) suggests that an airplane with high purchase and operational costs may still be desirable for an airline to utilize if the aircraft is able to produce enough extra revenue to compensate for its additional costs. This extra revenue may be gained by increased passenger appeal, or increased block speed. The HSCT would have greater passenger appeal and block speed than the current long-range aircraft, the Boeing 747. GE Aircraft Engines (1993) reports that a 300-passenger aircraft traveling at speeds nearing Mach 2.4
will be twice as productive as a comparably sized subsonic aircraft. The HSCT would be able to carry twice the number of passengers the same distance as a 300-passenger subsonic aircraft in the same amount of time. Significant cost-saving gains in productivity over a subsonic aircraft will be achieved if an airline can use the HSCT to operate two round-trips per day versus one round-trip per day with a subsonic aircraft. Consequently, a HSCT could cost twice as much to acquire, operate, and maintain as a subsonic transport, and still have the same daily cost per seat.

**Passenger benefits.** The president of Northwest Airlines, John Horn, suggests that an improvement in aircraft speed actually develops air travel markets (Lightfoot, 1988). Mr. Horn contends that in the 1930s only a few travelers flew across the United States because of the two days required to travel the distance. As faster, more reliable aircraft were introduced into service, more passengers began to fly across the country. The same phenomenon occurred in the transpacific market as jet service was introduced in the 1960s. In 1965, airlines carried 358,000 passengers across the Pacific Ocean in narrow-bodied jet aircraft. As the more comfortable Boeing 747 was introduced on transpacific routes, the passenger demand for service grew. In 1976, airlines carried 3.3 million passengers across the Pacific Ocean. It is anticipated that the HSCT, with its corresponding shorter travel times, will have the same stimulating effect on air travel demand across the Pacific Ocean.

Van der Velden (1988) suggests that passengers have a preferred travel time of four to six hours per day. By traveling only four to six hours per day and considering time zone changes, it is possible for business travelers on the east coast of the United States to leave their homes in the morning and conduct a full day of business on the west coast. If the flying time were longer, it would not be possible to achieve this benefit. Considering this theory, if it is possible for the HSCT to provide service from the west
coast of the United States to Asia in only four to six hours, the demand for travel will increase.

To determine if passengers will choose the HSCT over a subsonic transport, it is necessary to identify the advantages and disadvantages of flying on the HSCT from a passenger's perspective. Cathers (1990) suggests that the HSCT will stimulate business travel to the Pacific Rim, since the aircraft will make it possible for one-day business trips between the United States and Asia. With proper scheduling and consideration of local airport curfews, it will be possible for an aircraft traveling at Mach 2.4 to make two daily round-trips between Los Angeles and Tokyo. The first flight of the day would leave Los Angeles in the morning, and arrive in Tokyo a few hours before the start of the business day. A business traveler on this flight would have time to travel to a meeting site, conduct a full day of business, then fly back to Los Angeles on an evening HSCT flight.

An example of this improved flight schedule allowed by the HSCT can be seen by examining a typical schedule between Los Angeles and Tokyo. One important operational consideration affecting this route is the curfew in effect at Tokyo's Narita International Airport that prohibits all takeoffs and landings between 11 p.m. and 6 a.m. (Lightfoot, 1988). Currently, all westbound subsonic departures on this route leave Los Angeles between 11 a.m. and 4 p.m., arriving in Tokyo between 2:30 p.m. and 6 p.m. All eastbound flights leave Tokyo between 2 p.m. and 7 p.m., and arrive back in Los Angeles between 8 a.m. and 1 p.m. The time required for one subsonic round-trip is approximately 24 hours. With a Mach 2.4 aircraft, however, two round-trips per day could be operated by a single aircraft. Westbound passengers could leave Los Angeles at 10 a.m. or 10 p.m. for Tokyo, arriving at 6 a.m. or 6 p.m., respectively. After a two-hour turnaround time, the aircraft would leave Tokyo at 8 a.m. or 8 p.m., and arrive back in Los Angeles at 8 p.m. or 8 a.m., respectively. By giving passengers choices of travel
times that are more suited to the business day, demand for HSCT travel will be generated.

The Douglas Aircraft Company (1989) claims that the effects of jetlag would be lessened if passengers use a supersonic aircraft to cross the Pacific Ocean. Jetlag is caused when a person crosses too many time zones in the same trip and their body's two internal clocks become desynchronized. One internal clock, which controls the fluctuation of the body's temperature, is independent of external time cues. The second internal clock is rapidly affected by changes in external cues, such as daylight, and controls the sleep-wake cycle of the body (Folkard, Wever, & Wildgruber, 1983). Once the two clocks become desynchronized, symptoms of jetlag occur, including irritability, disorientation, fatigue, and lack of mental and physical energy. The body naturally resynchronizes the two clocks at a rate of approximately two hours per day. The sooner a person reaches the new time zone, the sooner the internal clocks can begin to correct themselves. While the HSCT can reduce the effects of jetlag by getting a passenger to the destination time zone quicker, jetlag can be eliminated for passengers who travel round-trip in the same day. By using the HSCT, business travelers could travel to a meeting in Asia and return without suffering any symptoms of jetlag (Douglas Aircraft Company, 1989).

The Douglas Aircraft Company (1989) also indicates that passengers will benefit by using high-speed travel because they will experience lower levels of physical hardship in the aircraft cabin. Even if seat size and comfort were identical to today's Boeing 747 or McDonnell Douglas MD-11, transpacific passengers will likely choose the HSCT because they will have to endure the discomforts of travel for only four to six hours instead of 10 to 12 hours.

The increase in speed provided by the HSCT could also potentially reduce passengers' enroute costs, such as hotel rooms and extra meals. It is not uncommon for passengers who travel to Asia or the South Pacific to have to make long layovers,
including overnight stops, on some routes. Layovers are necessary because operational
curfews at some airports, such as Tokyo's Narita International Airport, limit opportunities
to make flight connections. Each stop can require additional meal and possible hotel
expenses. Because of the higher speed, HSCT flights could be scheduled during different
times of the day. This improved schedule will give passengers greater opportunities to
make connections and still arrive at their destination airports at a reasonable hour
(Lightfoot, 1988).

Another characteristic of the HSCT that will attract passengers is discussed by
Swink and Goins (1992), who indicate that the HSCT will have the ability to land in
weather conditions that require most planes to divert to alternate airports. A state-of-the-art
synthetic vision system will give the HSCT autonomous Category III landing
capability, enabling the aircraft to land at any airport in Category III weather conditions.
Even if an airport's runways are not Category III certified, the synthetic vision system will
allow the HSCT to operate in vision-limiting weather, such as severe fog or rain. Having
an all-weather capability will benefit airlines and passengers by increasing operational
flexibility and dispatch reliability, as well as improving on-time performance.

**Fare surcharges.** Vachal (1990) suggests that, because of the additional
acquisition and operational costs of the HSCT, it will be necessary to charge a fare
premium for supersonic travel. Boeing estimates that even a 10% fare surcharge over
normal subsonic fares will cause a 15% to 50% drop in demand for supersonic air travel.
There is great concern that by requiring a fare surcharge, the only passengers attracted to
the HSCT will be the same elite, upper-class travelers who use today's Concorde service.
The Concorde, which has a 28% fare surcharge over first class fares, has only captured
50% of the transatlantic first class market (Piper, 1985). This fact indicates that nearly
half of the first class passengers in the North Atlantic market find the surcharge for
supersonic service to be too costly.
In 1986, a symposium to discuss the need for a high-speed commercial aircraft was held by the Center for High Speed Commercial Flight at the Battelle Memorial Institute (Loomis, 1986). Present at this symposium were representatives from government agencies, airlines, transportation consulting and research firms, banks, and airframe and powerplant manufacturers. At the end of the symposium, each participant was asked to complete a questionnaire about the anticipated market environment at the turn of the century for high-speed commercial air travel.

When asked how passengers would react to premium fares for supersonic service, most respondents indicated that any surcharge will decrease demand for the service. Business travelers will be more likely to pay a fare surcharge than leisure travelers, since business travelers are concerned with being as productive as possible on their trips. Businesses who send employees to Asia may find that the increased productivity made possible by the shorter travel time outweighs the added cost of supersonic air service. It has been suggested that premiums over the subsonic fare of 5-10% for coach class, 20-50% for business class, and 50-75% for first class will be tolerated by passengers for supersonic travel. Although survey respondents indicated a surcharge would be accepted by passengers, most agreed that in order for the aircraft to reach its full growth potential, it should operate with fares comparable to normal subsonic fares (Loomis, 1986).

When asked about new travel demand that a supersonic transport will help create, conference representatives gave a wide variety of responses. It was suggested that many service oriented businesses that charge hourly rates, such as law firms and consultants, will use the HSCT to reach clients faster than before, therefore reducing the client's expenses. The ability to reach more destinations faster also allows these service firms to expand their client base to more distant locations. It has been suggested that overnight letter and package delivery could be expanded to include more international destinations, further benefitting the business community (Loomis, 1986).
Summary. Through a cooperative effort between NASA, Boeing Commercial Airplane Group, Douglas Aircraft Company, GE Aircraft Engines, and Pratt & Whitney, technology for a new-generation commercial supersonic transport aircraft is being developed. This aircraft, the HSCT, will be capable of carrying 300 passengers over routes between 4,500 miles and 6,500 miles in length at speeds between Mach 1.8 and 2.4. There are still many technological challenges that will affect the design and operational capabilities of the HSCT. Engines for this aircraft must not emit ozone-destroying pollutants, or make noise on takeoff or landing that is greater than FAR Stage III limits. Since it will be impossible to eliminate the sonic boom produced at supersonic speeds, the HSCT will be restricted to subsonic speeds while over land. This speed restriction will reduce the number of routes that the HSCT will be able to serve efficiently and profitably.

Growth in air travel demand between the United States and the nations of the Pacific Rim is expected to continue at a rate of 8.8% per year. The FAA predicts that there will be 33 million transpacific passengers carried by American carriers in the year 2002. Boeing forecasts that there will be 600,000 daily HSCT passengers by the year 2015. The HSCT will be used primarily on long, overwater routes between the United States, Asia, and Europe.

Advantages gained by passengers who use the HSCT will include shorter travel time, less physical hardship, reduced jetlag, and a wider variety of departure times from which to choose. The disadvantage of the HSCT from a passenger's perspective, is that a fare surcharge over the normal subsonic fare is likely to be required. This surcharge will probably reduce demand for supersonic travel, and it is uncertain how many passengers would be willing to pay a surcharge for HSCT travel. By examining the criteria passengers use to select transpacific flights, it will be possible to project whether passengers will choose to use the HSCT over subsonic service.
Statement of the Hypothesis

The greatly reduced travel time made possible by the HSCT will benefit passengers by providing shorter travel times, less physical hardship, reduced jetlag, and a wider variety of departure times from which to choose. It is hypothesized that because of these advantages, passengers will choose the HSCT over subsonic transports for their mode of transportation across the Pacific Ocean.
Method

Sample

Travel agents sell between 75% and 85% of all airline tickets sold in the world and conduct business with international air travelers on a daily basis (Shaw, 1988). Since travel agents routinely make travel decisions for their clients and have a firsthand knowledge of client preferences, the views of professional travel agents were examined to predict passenger acceptance of the HSCT. The data for this study were collected by surveying the population of American Society of Travel Agents (ASTA) official representatives who work in travel agencies located in the Los Angeles, California metropolitan area. Since there is such a large number of ASTA representatives in this population, it was necessary to gather data from a randomly selected sample of the total population.

In order to insure the validity and reliability of the instrument, a pilot study was conducted. The pilot study sample included 40 ASTA travel agency representatives who conduct business in Los Angeles, California. The names of the ASTA travel agency representatives were obtained from the 1992 ASTA Membership Directory (1992). To select the representatives randomly, the membership list was numbered, then a random number generator was used to choose 40 numbers from the 204 in the population. The representatives were then selected by matching each random number obtained with the corresponding representative assigned in the ASTA membership directory.

Once the pilot study was returned, the response rate was calculated to be 10%, or four questionnaires. Since this response rate was extremely low, modifications were made in both the sample size and the instrument to insure an improved response rate for the actual study. A sample of 100 ASTA official representatives was used for the actual study, and included ASTA travel agency representatives in the entire Los Angeles metropolitan area, rather than just the City of Los Angeles. To reduce the number of

To select the representatives randomly, the membership list was numbered, then a random number generator was used to choose 100 numbers from the 728 in the population. The representatives were then selected by matching each random number obtained with the corresponding representative assigned in the ASTA membership directory. Since the method of sample selection was completely random, any sample bias introduced was insignificant.

**Instrument**

To predict passenger acceptance of supersonic air transportation across the Pacific Ocean, ASTA travel agency representatives were surveyed. Since there are no standardized instruments that specifically address this issue, a four page questionnaire was developed to use in this study. The instrument examined the importance that transpacific airline passengers place on flight duration to determine whether they will be willing to pay more for the substantially decreased flight time offered by the HSCT. The survey also compared the amount of fare surcharge that business and leisure passengers will be willing to pay for supersonic service. Further, suggested benefits, such as decreased jetlag and enroute costs, were put forth to determine if these are reasons why passengers will choose the HSCT over a subsonic transport.

The validity and reliability of the questionnaire were improved by conducting a pilot study that sampled ASTA travel agency representatives in Los Angeles, California. The pilot study included questions that asked the subjects to comment on the clarity and validity of the questionnaire. Respondents were also asked to make suggestions for questionnaire improvement. Since the rate of return for the pilot study was only 10%, the questionnaire was edited and shortened to increase the response rate. The answers to the pilot study questions were reviewed and updated to improve reliability and validity.
By comparing the main questionnaire (see Appendix A) and the pilot study questionnaire (see Appendix B), it is possible to identify the improvements which were made. The first question in the pilot study, which dealt with important flight-selection factors, was found to be too long and gathered more data than was actually needed. Since this study is only concerned with long-distance flights, it was not necessary to ask about short- and medium-distance flights. The portions of the question asking about flights under five hours in length were discarded.

The second question in the pilot study was concerned with the percentage of clients who request the shortest travel time when making transpacific air travel reservations. This question was found to be easily understood and beneficial to the study. Only a slight change in the wording of the question was made to include flights to the South Pacific.

The third question asked respondents to estimate the amount of fare surcharge that passengers in various service classes will be willing to pay over the subsonic fare for supersonic transportation. This question was found to be confusing and too lengthy. Most responses varied widely, making it unclear if the respondents really understood the question. The wording and design of this question were changed to increase the clarity and to reduce the size of the question on the page, thus making the questionnaire look less complicated.

The set of statements comprising the fourth part of the pilot study was edited to improve question clarity. Statements were added to determine how passengers will react to fare surcharges and whether passengers will benefit by having a full business day upon arrival in Asia.

The fifth question in the pilot study, which asked which city the respondent's travel agency was located, was considered redundant. Each questionnaire in the pilot study was number coded to give the respondent's address, therefore enabling the identification of the respondent's city without asking this question.
The sixth question asked about the primary product sold by each travel agency. The data gathered by this question were considered unnecessary for this study, so the question was eliminated.

The first open-ended question, which asked if business and leisure travelers will use supersonic service across the Pacific Ocean, was found to be a valuable source of information. To differentiate more clearly between business and leisure travelers, this question was divided into two separate parts. The second open-ended question, which asked about characteristics that a supersonic aircraft should have in order to be accepted by transpacific passengers, did not require any editing and was left in the main survey questionnaire. The final open-ended question on the pilot survey, which asked if the survey was easy to understand, was removed, since it was no longer needed.

Once the main survey questionnaire and cover letter were edited, they were mailed to randomly selected ASTA travel agency representatives in the Los Angeles, California metropolitan area. When the questionnaires were returned by mail, the data from each question were entered into a spreadsheet and a statistical analysis was conducted.

**Design**

The descriptive method of research was used for this study. This method, which is described by Gay (1992), uses questionnaires, opinionnaires, or interviews as instruments to collect data that are used to test a hypothesis concerning the attitudes of individuals toward a current issue. This research method was chosen because this study was concerned with collecting data to determine the current state of passenger preferences for air travel and suggesting future passenger use of the HSCT. Since passenger preference is influenced by a great number of variables, every effort was made to control each one during the conduct of this study. One important uncontrolled variable is the passage of time. Data were collected in 1993 and used to determine
passenger preference in the year 2008 at the earliest. Many unforeseen events can happen in the 15 years between the study and the first expected flight of the HSCT that may influence passenger preference for this aircraft.

By testing the hypothesis, the status of travel preferences of business and leisure air passengers was determined. Since most airline tickets are sold by travel agents, ASTA travel agency representatives, which include travel agency owners and managers, are aware of the preferences of most business and leisure air travelers and can estimate passenger use of the HSCT in the future. For this study, a questionnaire was used to gather all of the necessary data. A pilot study was conducted to test and update the procedures and instrument used for data collection.

**Procedure**

The instrument used for this study consisted of a self-developed questionnaire. Because the instrument had never been used before, it was necessary to complete a pilot study to insure that the survey collected the desired data. The validity of the questionnaire was improved by asking ASTA travel agency representatives to evaluate the questionnaire and to make suggestions for instrument improvement.

For the pilot study, a sample of 40 ASTA travel agency representatives who conduct business in Los Angeles, California was chosen from the official ASTA membership directory (1992). To select the representatives randomly, the membership list was numbered, then a random number generator was used to choose 40 numbers from the 204 in the population. The representatives were then selected by matching each random number obtained with the corresponding representative assigned in the ASTA membership directory. The recipients of the pilot study were urged to reply by a deadline that was approximately two weeks after receipt of the questionnaire. This request was used to prompt the return of the questionnaires and to improve data collection time.
After examining the returned pilot studies, the questionnaire was edited to correct misleading questions and to remove questions that did not elicit responses or were not necessary for the study. The rate of response to the pilot study was examined, and measures were taken to improve the rate of return, including editing the pilot study cover letter (see Appendix C). The pilot study cover letter was shortened and clarified to attract more respondents (see Appendix D).

Once the questionnaire was prepared for the main survey, an expanded sample of ASTA travel agency representatives who conduct business in the Los Angeles, California metropolitan area was randomly chosen from the total number listed in the ASTA membership directory. To select the representatives randomly, the membership list was numbered, then a random number generator was used to choose 100 numbers from the 728 in the population. The representatives were then selected by matching each random number obtained with the corresponding representative assigned in the ASTA membership directory. The recipients of the questionnaire were urged to reply by a deadline that was approximately two weeks after receipt of the questionnaire to prompt the return of the questionnaires and to improve data collection time.

Each questionnaire sent during the pilot study and the actual study was number coded to identify each respondent to the survey. To enhance the survey response rate, anonymity was offered to all subjects. Each subject's name is being kept strictly confidential by restricting access to the data that link the questionnaire to a specific respondent.
Results

After waiting a period of three weeks from the time the questionnaires were mailed out, it was assumed that no more questionnaires would be returned. A total of 31 questionnaires were returned by the deadline, giving a response rate of 31%. Once the responses were tabulated, an analysis of the data was conducted to determine if business and leisure airline passengers traveling across the Pacific Ocean would choose a supersonic aircraft for their travel needs if one were available.

Question 1

The first question, shown below, was designed to identify the most important criteria used by business and leisure travelers when selecting a transpacific flight. A summary of the responses to Question 1 is shown in Table 1.

(1) Please check the box which you feel indicates the most important factor your clients use to select a flight to Asia or the South Pacific in each case:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1: Business Traveler</th>
<th>Case 2: Leisure Traveler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airline’s Reputation</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Fare</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Frequent Flyer Program</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Aircraft Type</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Schedule</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Other (write in):</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1

Most Important Factor Used to Select a Transpacific Flight

<table>
<thead>
<tr>
<th>Factor</th>
<th>Business travelers</th>
<th>Leisure travelers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>Airline Reputation</td>
<td>1</td>
<td>4.1%</td>
</tr>
<tr>
<td>Fare</td>
<td>3</td>
<td>12.5%</td>
</tr>
<tr>
<td>Frequent Flyer Program</td>
<td>10</td>
<td>41.7%</td>
</tr>
<tr>
<td>Aircraft Type</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Schedule</td>
<td>10</td>
<td>41.7%</td>
</tr>
</tbody>
</table>

The data collected from Question 1 are graphically displayed in Figure 1. It is clear from these results that business travelers and leisure travelers use different criteria when choosing flights to Asia and the South Pacific.

Figure 1. Most Important Factor Used to Select a Transpacific Flight.
Of the respondents, 41.7% indicated that business travelers select flights based primarily on schedule convenience. Another 41.7% of the respondents indicated that business travelers select flights because of frequent flyer program participation. A convenient flight schedule is important to business travelers because they wish to maximize their productivity while on a trip and return home as soon as possible. If flights are offered at convenient times, business travelers can attend meetings in different cities on the same day and return to their homes at night. Frequent flyer programs have been used successfully by airlines to promote brand loyalty among air travelers by awarding free travel after a specified number of miles have been flown. Transpacific business passengers are especially interested in frequent flyer programs, since each transpacific flight they take across the Pacific Ocean earns them several thousand miles of frequent flyer credit.

Of the respondents to the survey, 96.1% indicated that leisure passengers are most concerned with the fare required for the trip. Since leisure travelers generally use disposable income to pay for a trip, they consider the total cost of the trip before they decide to leave home. Many leisure passengers are willing to choose an itinerary with longer flight times or at inconvenient departure times if the fare is less expensive. Leisure passengers are also less concerned with schedules and frequent flyer programs than business travelers.

Only 12.5% of the respondents to this survey indicated that business travelers are primarily concerned about the cost of the trip when selecting a transpacific flight. Business travelers are less concerned about ticket cost than leisure passengers because business travelers usually do not have to pay for their ticket from their personal resources. A company normally sends an employee on a trip to perform work that will generate revenue for the company. As long as a company expects to receive economic benefit from the trip, employee travel expenses will be reimbursed.
Question 2

The second question, shown below, was designed to determine how much consideration passengers give to length of travel time when selecting a flight across the Pacific Ocean. This question also attempts to determine if saving time is more important to business travelers or to leisure travelers. The responses to this question are shown graphically in Figure 2.

(2) In your best estimate, what percentage of your clients who request airline reservations to Asia or the South Pacific ask for a flight which offers the shortest travel time?

100% = every client asks for the shortest flight time
0% = no client asks for the shortest flight time

Business Clients _______ %
Leisure Clients _______ %

Figure 2. Percent of Passengers Who Request Shortest Transpacific Flight.
The responses to this question covered the full range of 0% to 100% for both business and leisure travelers. The mean percent of business passengers requesting the shortest flight was 64.0% with a standard deviation of 33.8. The mean percent of leisure passengers requesting the shortest flight was 44.2% with a standard deviation of 36.0. With such a varied distribution of responses, it is not possible to identify accurately a specific percentage of travelers who request the shortest flight when making air travel reservations.

The data do indicate, however, that business travelers request the shortest flight time more frequently than leisure travelers. Of the respondents to this question, 54.8% indicated that business travelers ask for the shortest flight time more frequently than leisure travelers. Additionally, 41.9% of the respondents felt that there is no difference between business and leisure passengers when requesting the shortest flight time. Only 3.2% of the questionnaires indicated that leisure passengers ask for the shortest flight time more frequently than business passengers.

In summary, the responses to this question indicate that many transpacific passengers are concerned with finding the shortest flight time. Business travelers are more concerned about flight time length than leisure travelers, presumably because they wish to complete their assignments as quickly as possible and return home. Conversely, leisure passengers tend to be on a more flexible schedule and are less concerned about arriving at their destination as quickly as possible.

**Question 3**

The purpose of the third question was to suggest a maximum surcharge over subsonic fares that travelers will be willing to pay for supersonic air service across the Pacific Ocean. The question was divided into two main parts to include both business passengers and leisure passengers. Each of the two main sections was broken down further to include passengers traveling in first class, business class, and coach class. The
first half of the question, shown below, asked about passengers traveling for business purposes. The responses for business passengers traveling in first class are shown graphically in Figure 3.

(3a) What do you feel is the largest percent over the normal subsonic fare that Business Passengers will be willing to pay for supersonic service in each of the following service classes?

- First Class  _____ %
- Business Class  _____ %
- Coach Class  _____ %

Figure 3. Maximum Supersonic Fare Surcharge for Business Travelers in First Class.
The responses to this part of the question varied widely, covering a range of 0% to 200% surcharge. Since it is highly unlikely that anyone will pay a 200% premium for air travel, this data point was not included in the calculations of mean and standard deviation. The mean maximum fare surcharge suggested for business travelers in first class was 26.8% over subsonic first class fares. The standard deviation was 21.4, which is large because of the wide range of responses to this question. The response given most frequently, the mode, was a 15% surcharge. Of all the data, 31% of the responses were in the 10% to 19% surcharge range, and 75% of the responses were in the 0% to 39% surcharge range.

The responses for business passengers traveling in business class are shown graphically in Figure 4.
The responses to this part of the question covered a range of 0% to 100% surcharge. The mean maximum fare surcharge suggested for business travelers in business class was 27.4% over subsonic business class fares. The standard deviation was 24.5, which is large because of the wide range of responses to this question. The response given most frequently, the mode, was a 20% surcharge. Of all the data, 35% of the responses were in the 20% to 29% surcharge range, and 75% of the responses were in the 0% to 39% surcharge range.

The responses for business passengers traveling in coach class are shown graphically in Figure 5.

![Figure 5](image-url)  
**Figure 5.** Maximum Supersonic Fare Surcharge for Business Travelers in Coach Class.
The responses to this part of the question covered a range of 0% to 59% surcharge. The mean maximum fare surcharge suggested for business travelers in coach class was 15.4% over subsonic coach class fares. The standard deviation was 12.9. The response given most frequently, the mode, was a 10% surcharge. Of all the data, 43% of the responses were in the 10% to 19% surcharge range, and 93% of the responses were in the 0% to 29% surcharge range.

The second half of the second question on the survey, shown below, asked about passengers traveling for leisure purposes. The responses for leisure passengers traveling in first class are shown graphically in Figure 6.

(3b) What do you feel is the largest percent over the normal subsonic fare that Leisure Passengers will be willing to pay for supersonic service in each of the following service classes?

First Class
Business Class
Coach Class

Figure 6. Maximum Supersonic Fare Surcharge for Leisure Travelers in First Class.
The responses to this part of the question covered a range of 0% to 90% surcharge. The mean maximum fare surcharge suggested for leisure travelers in first class was 18.5% over subsonic first class fares. The standard deviation was 18.9, which is large because of the wide range of responses to this question. The data for this portion of the question were multi-modal, since the responses of 0%, 10%, and 20% surcharge were present with equal frequency. Of all the data, 75% of the responses were in the 0% to 29% surcharge range.

The responses for leisure passengers traveling in business class are shown graphically in Figure 7.

![Figure 7. Maximum Supersonic Fare Surcharge for Leisure Travelers in Business Class.](image)
The responses to this part of the question covered a range of 0% to 59% surcharge. The mean maximum fare surcharge suggested for leisure travelers in business class was 15.4% over subsonic business class fares. The standard deviation was 11.6. The response given most frequently, the mode, was 10%. Of all the data, 32% of the responses were in the 20% to 29% surcharge range, and 89% of the responses were in the 0% to 29% surcharge range.

The responses for leisure passengers traveling in coach class are shown graphically in Figure 8.

Figure 8. Maximum Supersonic Fare Surcharge for Leisure Travelers in Coach Class.
The responses to this part of the question covered a range of 0% to 59% surcharge. The mean maximum fare surcharge suggested for leisure travelers in coach class was 9.5% over subsonic coach class fares. The standard deviation was 11.6. The response given most frequently, the mode, was a 0% surcharge. In fact, 39% of the respondents agreed that leisure passengers will not be willing to pay any surcharge at all. Of all the data, 50% of the responses were in the 0% to 9% surcharge range, and 82% of the responses were in the 0% to 19% surcharge range. Table 2 shows a summary of the entire statistical analysis for this question.

Table 2

Suggested Supersonic Fare Surcharges for Various Classes of Service

<table>
<thead>
<tr>
<th>Passenger Type</th>
<th>Mode</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Travelers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Class</td>
<td>15%</td>
<td>26.8%a</td>
<td>21.4a</td>
</tr>
<tr>
<td>Business Class</td>
<td>20%</td>
<td>27.4%</td>
<td>24.5</td>
</tr>
<tr>
<td>Coach Class</td>
<td>10%</td>
<td>15.4%</td>
<td>12.9</td>
</tr>
<tr>
<td>Leisure Travelers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Class</td>
<td>0, 10, 20%</td>
<td>18.5%</td>
<td>18.9</td>
</tr>
<tr>
<td>Business Class</td>
<td>10%</td>
<td>15.4%</td>
<td>11.6</td>
</tr>
<tr>
<td>Coach Class</td>
<td>0%</td>
<td>9.5%</td>
<td>11.6</td>
</tr>
</tbody>
</table>

*a*Calculated without using data point of 200% surcharge.

After reviewing the data, it is apparent that there are many differing opinions regarding how much passengers will be willing to pay for supersonic air service across the Pacific Ocean. The difference in opinions reflects the many different factors that
influence a person's decision to purchase air travel. Since each traveler's reason for taking a trip is different, each traveler's willingness to pay a premium will be different. The data collected in this survey do suggest that business passengers in all classes of service will most likely be willing to pay a fare surcharge for supersonic air service. The data also suggest that leisure passengers who travel in first and business classes will be willing to pay a supersonic fare surcharge. Leisure passengers who fly in coach class, however, will most likely be unwilling to pay a fare surcharge for supersonic service, and will choose the least expensive form of air transportation.

Question 4

The fourth question on the survey asked respondents to agree or disagree with statements related to benefits provided by supersonic air transportation. For data collection, a Likert scale was used that required each subject to circle one of five replies, including strongly agree (SA), agree (A), undecided (U), disagree (D), or strongly disagree (SD). Since this section used a Likert scale, each statement was presented in both positive and negative forms.

The first pair of statements, shown below, was used to determine if passengers using a supersonic aircraft will experience a decrease in enroute costs. The responses to this question are shown in Table 3.

(4a) By using a supersonic aircraft, passengers' enroute costs will be reduced, since extra meals and hotel rooms will be avoided.

(4f) Supersonic passengers will have the same stopover costs, such as hotel rooms and extra meals, as subsonic passengers.
Table 3

Responses to Questions 4a and 4f

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA</td>
<td>1</td>
<td>3.2%</td>
<td>2</td>
<td>6.4%</td>
</tr>
<tr>
<td>A</td>
<td>13</td>
<td>41.9%</td>
<td>12</td>
<td>38.7%</td>
</tr>
<tr>
<td>U</td>
<td>3</td>
<td>9.7%</td>
<td>8</td>
<td>25.8%</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
<td>32.2%</td>
<td>8</td>
<td>25.8%</td>
</tr>
<tr>
<td>SD</td>
<td>4</td>
<td>12.9%</td>
<td>1</td>
<td>3.2%</td>
</tr>
</tbody>
</table>

By examining the responses to this question, it is clear that the subjects were unsure whether a passenger will experience reduced enroute expenses by flying on a supersonic aircraft. In the positive form, 45.1% of the respondents agreed or strongly agreed with the statement, while 45.1% of the respondents disagreed or strongly disagreed with the statement. In the negative form of the question, 45.1% of the respondents agreed or strongly agreed that passengers will have the same enroute expenses, regardless of their mode of air travel. The inconsistency of the responses to the positive and negative forms of this question indicates that there are probably instances where some passengers will experience reduced enroute costs while other passengers will not.

The second pair of statements, shown below, was used to determine if the use of a supersonic aircraft on transpacific routes will reduce the effects of jetlag on passengers. The responses to this question are shown in Table 4.

4b) Using a supersonic aircraft will reduce the effects of jetlag on transpacific passengers.

4g) Supersonic passengers to Asia and the South Pacific will be affected by jetlag the same as subsonic passengers.
Table 4

Responses to Questions 4b and 4g

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
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<td>14</td>
<td>45.2%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>A</td>
<td>11</td>
<td>35.5%</td>
<td>8</td>
<td>25.8%</td>
</tr>
<tr>
<td>U</td>
<td>3</td>
<td>9.7%</td>
<td>7</td>
<td>22.6%</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>9.7%</td>
<td>14</td>
<td>45.2%</td>
</tr>
<tr>
<td>SD</td>
<td>0</td>
<td>0.0%</td>
<td>2</td>
<td>6.4%</td>
</tr>
</tbody>
</table>

The respondents to this question clearly felt that a supersonic aircraft will help reduce the effects of jetlag caused by long transpacific flights. In fact, 80.7% of the respondents agreed or strongly agreed to the positive form of the statement which indicated that jetlag will be reduced by flying on a supersonic aircraft. Replies to the negative form of the question indicated that 51.6% of the respondents disagreed or strongly disagreed with the statement which indicated that jetlag will effect subsonic and supersonic passengers in the same manner.

The third pair of statements, shown below, was included to determine if passengers will use a supersonic aircraft over a subsonic aircraft if the fare is identical. The responses to this question are shown in Table 5.

4c) Even if the transpacific supersonic fare is the same as the normal jet fare, passengers will not choose the supersonic aircraft for their travels.

4j) If the transpacific supersonic fare is the same as the normal jet fare, passengers will choose the supersonic aircraft for their travels.
Table 5

Responses to Questions 4c and 4j

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA</td>
<td>0</td>
<td>0.0%</td>
<td>14</td>
<td>45.2%</td>
</tr>
<tr>
<td>A</td>
<td>0</td>
<td>0.0%</td>
<td>17</td>
<td>54.8%</td>
</tr>
<tr>
<td>U</td>
<td>1</td>
<td>3.2%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>25.8%</td>
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<tr>
<td>SD</td>
<td>22</td>
<td>70.1%</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

The respondents to this question overwhelmingly indicated that if no fare surcharge is placed on supersonic flights, passengers will choose supersonic service over subsonic service. In fact, 100% of the respondents indicated that they agreed or strongly agreed with the positive form of the statement, and 95.9% of the respondents disagreed or strongly disagreed with the negative form of the statement.

The fourth pair of statements, shown below, was designed to determine if a new supersonic aircraft will generate demand for transpacific air travel. The responses to this question are shown in Table 6.

4d) A supersonic aircraft will not create additional demand for transpacific air travel.

4h) A transpacific supersonic aircraft will create additional demand for air travel to Asia and the South Pacific.
Table 6

Responses to Questions 4d and 4h

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA</td>
<td>2</td>
<td>6.4%</td>
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<td>3.2%</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>9.7%</td>
<td>16</td>
<td>51.6%</td>
</tr>
<tr>
<td>U</td>
<td>11</td>
<td>35.5%</td>
<td>7</td>
<td>22.6%</td>
</tr>
<tr>
<td>D</td>
<td>12</td>
<td>38.7%</td>
<td>6</td>
<td>19.4%</td>
</tr>
<tr>
<td>SD</td>
<td>3</td>
<td>9.7%</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

The respondents to this question indicated that a supersonic aircraft will increase demand for transpacific air travel. Replies to the positive form of the question indicated that 54.8% of the respondents agreed or strongly agreed that transpacific travel demand will increase if a supersonic aircraft were introduced on transpacific routes. Replies to the negative form of the question indicated that 48.4% of the respondents disagreed or strongly disagreed with the statement that indicated no demand will be created if a supersonic aircraft were introduced on transpacific routes. Many respondents were unsure about the demand-generating capabilities of a supersonic aircraft in the transpacific market.

The final pair of statements, shown below, was used to determine if business travelers will benefit by being able to conduct a full day of business upon arrival in Asia. This benefit will be made possible by using a supersonic transpacific aircraft. The responses to the question are shown in Table 7.
4e) Business travelers will benefit by being able to conduct a full day of business upon arrival in Asia.

4i) Business travelers will not benefit by being able to conduct a full day of business upon arrival in Asia.

Table 7

Responses to Questions 4e and 4i

<table>
<thead>
<tr>
<th>Response</th>
<th>4e) Travelers will benefit from a full day upon arrival.</th>
<th>4i) Travelers will not benefit from a full day upon arrival.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>SA</td>
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<td>A</td>
<td>20</td>
<td>64.5%</td>
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<tr>
<td>U</td>
<td>2</td>
<td>6.4%</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>6.4%</td>
</tr>
<tr>
<td>SD</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

The responses to this question overwhelmingly indicated that business travelers will benefit by having a full day available upon arrival in Asia. In fact, 87.1% of the respondents indicated that they agreed or strongly agreed with the positive form of the statement. Similarly, 87.1% of the respondents disagreed or strongly disagreed with the statement indicating that business travelers will not benefit by having a full day available upon arrival in Asia. It is clear that this scheduling improvement will be considered advantageous to business travelers and will attract them to supersonic air service.

Question 5

The fifth question on the survey, shown below, was designed to determine if business travelers will choose a supersonic aircraft for trips to Asia and the South Pacific.
(5) Do you feel that passengers traveling for Business will choose a supersonic aircraft as their mode of transportation for trips to Asia and the South Pacific? Why or why not?

Since this is an open-ended question, the statements given by the respondents vary in length and content (see Appendix E). When asked if business travelers will choose a supersonic aircraft for transpacific flights, 80% of the respondents agreed that they will. The remaining 20% of the respondents indicated that business travelers will use a supersonic aircraft, but only if the fares are acceptable. It was noted by six respondents that business travelers will not choose a supersonic aircraft if the cost of the service is too high. One travel agent suggested that if the additional cost of a supersonic ticket is offset by benefits to the traveler, such as increased number of hours to conduct business or improved alertness upon arrival, then business travelers will use the supersonic service.

When asked why business travelers will choose a supersonic aircraft for their travels, there were four answers that appeared with the most frequency. Table 8 shows the responses and their frequency.

Table 8
Reasons Why Business Travelers Will Choose Supersonic Service

<table>
<thead>
<tr>
<th>Reason</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shorter travel time, improved productivity</td>
<td>23</td>
</tr>
<tr>
<td>Improved comfort</td>
<td>3</td>
</tr>
<tr>
<td>Improved alertness, less jetlag</td>
<td>3</td>
</tr>
<tr>
<td>Less boredom</td>
<td>2</td>
</tr>
</tbody>
</table>
Most travel agents felt that business passengers will be attracted to a supersonic aircraft because of the time savings it provides. Many indicated that this time saved could be used productively by business travelers, therefore adding value to the transpacific air service product for which many business travelers will be willing to pay extra. Other suggestions given, such as improved comfort and decreased jetlag, show that business passengers are concerned not only with arriving quickly, but also in arriving in a well rested state so that they may effectively conduct business.

Question 6

The sixth question on the survey, shown below, was designed to determine if leisure travelers will choose a supersonic aircraft for trips to Asia and the South Pacific.

(6) Do you feel that passengers traveling for Leisure will choose a supersonic aircraft as their mode of transportation for trips to Asia and the South Pacific? Why or why not?

Since this is an open-ended question, the statements given by the respondents vary in length and content (see Appendix F). When asked if leisure travelers will choose a supersonic aircraft for transpacific flights, 43% of the respondents indicated that they will as long as fares were reasonable. Another 33% of the respondents agreed that leisure passengers will choose a supersonic flight without conditions, while 3% of the respondents believed that leisure passengers will choose a supersonic flight only if the schedule is convenient. Of the respondents, 13% indicated that leisure passengers will not use a supersonic aircraft. Finally, 7% of the respondents were unsure if leisure passengers will choose a supersonic aircraft.

When asked why leisure travelers will choose a supersonic aircraft for their travels, there were four answers that appeared with the most frequency. Table 9 shows these responses and their frequency.
Table 9

Reasons Why Leisure Travelers Will Choose Supersonic Service

<table>
<thead>
<tr>
<th>Reason</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shorter travel time</td>
<td>9</td>
</tr>
<tr>
<td>Improved comfort</td>
<td>3</td>
</tr>
<tr>
<td>Improved alertness, less jetlag</td>
<td>2</td>
</tr>
<tr>
<td>Less boredom</td>
<td>2</td>
</tr>
</tbody>
</table>

As shown in Table 9, most travel agents felt that leisure passengers will be attracted to a supersonic aircraft because of the time savings. One travel agent indicated that a shorter travel time will enable travelers with limited vacation time to visit more distant places. Another travel agent remarked that upscale and status-conscious leisure travelers will choose to fly on a supersonic aircraft. Other reasons given, such as improved comfort and decreased jetlag, show that leisure passengers are also concerned about arriving in a more rested state so that they may begin their sightseeing.

There were several reasons given why leisure travelers will not choose a supersonic aircraft for transpacific travel. The first reason, and most frequent with 15 responses, was increased cost. One respondent indicated that since leisure travelers are using their own discretionary money, and not their company's money to pay for the trip, many look for the absolute lowest fare. It was felt that these price-conscious passengers will not be willing to pay extra for supersonic service. Another reason given for not choosing a supersonic aircraft is that many leisure travelers are less concerned with the length of travel time and the number of stopovers required to reach their destination. Many leisure travelers are more relaxed while on vacation and are generally not in a rush to get to their destination. Finally, one travel agent suggested that passengers will continue to fly on subsonic aircraft if the supersonic schedule is not convenient.
Question 7

The final question on the survey, shown below, asked travel agents to provide characteristics which they feel a supersonic aircraft must possess in order to be accepted by passengers.

(7) What characteristics do you feel a supersonic aircraft must have in order to be accepted by passengers in the Pacific market?

Since this is an open-ended question, the statements given by the respondents vary in length and content (see Appendix G). Table 10 shows the responses mentioned most frequently by the respondents in their answers to this question.

Table 10

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfort</td>
<td>13</td>
</tr>
<tr>
<td>Reasonable fares</td>
<td>12</td>
</tr>
<tr>
<td>Good service</td>
<td>11</td>
</tr>
<tr>
<td>Convenient schedule</td>
<td>7</td>
</tr>
<tr>
<td>Safety</td>
<td>5</td>
</tr>
</tbody>
</table>

Travel agents indicated that the most important characteristic necessary for passengers' acceptance of the aircraft is cabin comfort. Travelers are concerned about their comfort during flight and prefer reasonable seat size and leg room. It was suggested by one travel agent that a new supersonic aircraft must be at least as comfortable as its subsonic competitors to be accepted by passengers.
The second most important factor suggested was reasonable fares for both business and leisure passengers. It is clear that most passengers will not choose a supersonic aircraft if the fares are too expensive. Good service, including appetizing food, accurate and timely baggage handling, aircraft dependability, and a frequent-flyer program, is also necessary for passenger acceptance of the aircraft. The schedule must be convenient for the passengers, otherwise they will not use the service. Finally, the safety record of any supersonic aircraft must be impeccable. Passengers will not fly at speeds of over twice the speed of sound if they do not feel safe.

Summary

Survey data indicate that business travelers primarily consider flight schedule and frequent flyer program participation when selecting a transpacific flight. Business travelers are more concerned with finding the shortest flight time to their destination than leisure passengers and will be willing to pay a fare surcharge of up to approximately 30% over subsonic fares for supersonic service across the Pacific Ocean. Business travelers will be attracted to the HSCT because of the shorter travel time, more convenient schedule, improved comfort, and reduced jetlag made possible by the aircraft. By flying to Asia on a supersonic aircraft, travelers will arrive alert and ready to conduct business.

Leisure passengers primarily consider ticket price when making travel arrangements. Leisure travelers are not as concerned as business travelers about finding the shortest flight time, since leisure travelers generally have a more flexible schedule and are not rushed. The data suggest that only wealthy leisure passengers or passengers with a limited time for vacation will be willing to pay a surcharge of up to 30% over subsonic fares for supersonic service. It is highly unlikely that a price-conscious leisure traveler will pay any surcharge if a less expensive subsonic flight is available. Leisure passengers will be attracted to the HSCT because of the shorter travel time, improved comfort, and reduced jetlag that it provides.
Travel agents were unsure whether passengers will experience a decrease in stopover costs as a result of using a supersonic aircraft to cross the Pacific Ocean. Most respondents agreed, however, that passengers who use a supersonic aircraft will experience reduced effects of jetlag and will benefit by having a full business day upon arrival in Asia. All respondents indicated that if there is no fare surcharge, passengers will choose supersonic transportation over subsonic transportation. Travel agents agreed that a supersonic aircraft will increase demand for transpacific air travel. Finally, travel agents suggested that a supersonic aircraft must have comfort, reasonable fares, good service, a convenient schedule, and an impeccable safety record to be accepted by air travelers.
Conclusions

The purpose of this study was to determine if business and leisure airline passengers originating in the United States will choose a supersonic aircraft, such as the High Speed Civil Transport (HSCT), as their mode of air transportation on long, overwater routes between the United States and Asia and the South Pacific. It has been suggested that the greatly reduced travel time made possible by the HSCT will benefit passengers by providing shorter travel times, less physical hardship, reduced jetlag, and a wider variety of departure times from which to choose. Further, it was hypothesized that because of these advantages, air travelers will choose the HSCT over subsonic transports for their mode of transportation across the Pacific Ocean.

In order to accept or reject the hypothesis of this study, it is necessary to review the data analysis for both business and leisure travelers. The data obtained from the survey of travel agents indicate that business travelers primarily consider flight schedule and frequent-flyer program participation when selecting a transpacific flight. Further, business travelers are more concerned with finding the shortest flight time to their destination than are leisure passengers. Most travel agents who responded to the questionnaire used in this study agreed that passengers using a supersonic aircraft on transpacific flights will experience fewer effects of jetlag than subsonic passengers. By flying to Asia on a supersonic aircraft, travelers will arrive alert and ready to conduct business. Based on these results, it is believed that business travelers will be attracted to the HSCT because of the shorter travel time, more convenient schedule, improved comfort, and reduced jetlag made possible by the aircraft. Because of the greatly increased value that business travelers will receive by flying on a supersonic aircraft, it is suggested that they will be willing to pay a fare surcharge for this service of up to 30% over subsonic fares.

A majority of leisure passengers primarily consider ticket price when making travel arrangements. Leisure travelers are not as concerned as business travelers about
finding the shortest flight time, since leisure travelers generally have a more flexible schedule and are not rushed. Survey results suggest that only wealthy leisure passengers or passengers with a limited time for vacation will be willing to pay a surcharge of up to 30% over subsonic fares for supersonic service. It is highly unlikely that a price-conscious leisure traveler will pay any surcharge if a less-expensive subsonic flight is available. Leisure passengers will be attracted to the HSCT because of the shorter travel time, improved comfort, and reduced jetlag that it provides.

In summary, the demand for HSCT travel on routes from the United States to Asia and the South Pacific will depend primarily on the amount of fare surcharge required. If no surcharge is required for supersonic travel, data suggest that both business and leisure travelers will choose the HSCT for their travels. Passengers will choose to use a transpacific supersonic service because of the shorter travel time, improved comfort, reduced jetlag and more convenient schedule which the aircraft will provide.

If a fare surcharge is necessary to compensate for the increased acquisition and operational costs of the HSCT, it is highly likely that demand for supersonic service will be reduced. Data suggests that a majority of the transpacific business travelers and wealthy leisure travelers will be willing to pay a fare surcharge of up to 30% over subsonic fares. Price-conscious leisure passengers will not be willing to pay a fare surcharge for supersonic service and will choose a subsonic flight for their travel needs. Based on this study, the HSCT will be an economically successful aircraft so long as there are enough business travelers and wealthy leisure travelers who desire transportation on transpacific routes. It is also evident that the HSCT will reduce the business and first class demand for subsonic air service, since a majority of these passengers will elect to fly using supersonic air service.
Recommendations

The scope of this study was limited to the Los Angeles, California area, because this area will play a major role in high-speed air transportation across the Pacific Ocean. Further studies could be made which examine other potential markets for the HSCT. One of the most heavily traveled international air corridors in the world exists between the United States and Europe. The routes across the Atlantic ocean are well suited for HSCT travel because they are primarily long, heavily traveled routes which are over water for most of the flight. Future studies could examine the United States as a whole using a stratified sample with data collected from major cities along both the east and west coasts of the country.

Another point of view which would be useful to obtain is that of Japanese travelers. Since approximately 60% to 65% of the passengers bound from Japan for the United States are Japanese, these travelers make up a large percentage of the potential HSCT passengers. It would be beneficial to determine how much of a fare surcharge Japanese business and leisure passengers are willing to pay for HSCT service. From the Japanese perspective, an airline with a fleet of HSCTs based in Japan would have a logistical advantage over U.S. carriers. A hub-and-spoke network could be created in Japan allowing passengers from the United States to connect with intra-Asian subsonic and supersonic flights. This network will enable passengers to reach their destinations more quickly than a subsonic flight directly from the United States.

A more direct method of determining passenger preferences and willingness to pay a fare surcharge for supersonic travel would be to survey transpacific airline passengers. This type of survey could be conducted by placing questionnaires on transpacific flights currently operated by the world's airlines over potential HSCT routes. Logistically, a survey of this magnitude would require assistance from the operations and marketing departments of the airlines involved. This direct survey method would be an
excellent way for airlines to determine whether their passengers will choose a supersonic aircraft over a subsonic aircraft for their travel needs.

Since this study suggested that business travelers will be the primary users of the HSCT, it would be beneficial to learn more about the preferences and characteristics of business travelers. Corporate travel planners could be surveyed to determine long-distance air transportation preferences of their employers. The industry and organizational position of business travelers who would most likely use a supersonic aircraft for their travel needs could also be identified. If certain industries are consistently mentioned, the success of a supersonic transport could be forecast by examining the growth forecasts for these specific industries.
References


Appendix A: Transpacific Air Travel Questionnaire

(1) Please check the box which you feel indicates the most important factor your clients use to select a flight to Asia or the South Pacific in each case:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1: Business Traveler</th>
<th>Case 2: Leisure Traveler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airline's Reputation</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Fare</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Frequent Flyer Program</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Aircraft Type</td>
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<td>□</td>
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<tr>
<td>Schedule</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Other (write in):</td>
<td>__________________________</td>
<td>__________________________</td>
</tr>
</tbody>
</table>

(2) In your best estimate, what percentage of your clients who request airline reservations to Asia or the South Pacific ask for a flight which offers the shortest travel time?

100% = every client asks for the shortest flight time
0% = no client asks for the shortest flight time

Business Clients        %
Leisure Clients        %
Today, subsonic jet aircraft such as the 747 require approximately 10 to 15 hours to fly from Los Angeles to destinations across the Pacific Ocean. With a new-generation supersonic aircraft, it will be possible to fly to most transpacific destinations in 4 to 5 hours. Due to the expense of this new aircraft, airlines may need to add a surcharge to the normal jet fares for supersonic flights. The following questions will ask you to estimate the largest fare surcharge that passengers will be willing to pay to use the supersonic service.

(3a) What do you feel is the largest percent over the normal subsonic fare that Business Passengers will be willing to pay for supersonic service in each of the following service classes?

- First Class _______%
- Business Class _______%
- Coach Class _______%

(3b) What do you feel is the largest percent over the normal subsonic fare that Leisure Passengers will be willing to pay for supersonic service in each of the following service classes?

- First Class _______%
- Business Class _______%
- Coach Class _______%
Please indicate whether you strongly agree (SA), agree (A), are undecided (U), disagree (D), or strongly disagree (SD) with the following statements.

(4a) By using a supersonic aircraft, passengers' enroute costs will be reduced, since extra meals and hotel rooms will be avoided
SA A U D SD

(4b) Using a supersonic aircraft will reduce the effects of jetlag on transpacific passengers
SA A U D SD

(4c) Even if the transpacific supersonic fare is the same as the normal jet fare, passengers will not choose the supersonic aircraft for their travels
SA A U D SD

(4d) A supersonic aircraft will not create additional demand for transpacific air travel
SA A U D SD

(4e) Business travelers will benefit by being able to conduct a full day of business upon arrival in Asia.
SA A U D SD

(4f) Supersonic passengers will have the same stopover costs, such as hotel rooms and extra meals, as subsonic passengers
SA A U D SD

(4g) Supersonic passengers to Asia and the South Pacific will be affected by jetlag the same as subsonic passengers
SA A U D SD

(4h) A transpacific supersonic aircraft will create additional demand for air travel to Asia and the South Pacific
SA A U D SD

(4i) Business travelers will not benefit by being able to conduct a full day of business upon arrival in Asia
SA A U D SD

(4j) If the transpacific supersonic fare is the same as the normal jet fare, passengers will choose the supersonic aircraft for their travels
SA A U D SD
(5) Do you feel that passengers traveling for **Business** will choose a supersonic aircraft as their mode of transportation for trips to Asia and the South Pacific? Why or why not?

(6) Do you feel that passengers traveling for **Leisure** will choose a supersonic aircraft as their mode of transportation for trips to Asia and the South Pacific? Why or why not?

(7) What characteristics do you feel a supersonic aircraft must have in order to be accepted by passengers in the Pacific market?

Thank you for your help!
### Appendix B: Transpacific Air Travel Pilot Study Questionnaire

(1a) Considering your clients, please check the box which you feel indicates the most important factor that a **Business Traveler** uses to select a flight in each case:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1: Flights shorter than 2 hours</th>
<th>Case 2: Flights from 2 to 5 hours</th>
<th>Case 3: Flights longer than 5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airline</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Fare</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Aircraft Type</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Schedule</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Other (write in):</td>
<td>_________</td>
<td>_________</td>
<td>_________</td>
</tr>
</tbody>
</table>

(1b) Considering your clients, please check the box which you feel indicates the most important factor that a **Leisure Traveler** uses to select a flight in each case:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Case 1: Flights shorter than 2 hours</th>
<th>Case 2: Flights from 2 to 5 hours</th>
<th>Case 3: Flights longer than 5 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airline</td>
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<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Fare</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Aircraft Type</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Schedule</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Other (write in):</td>
<td>_________</td>
<td>_________</td>
<td>_________</td>
</tr>
</tbody>
</table>

(2) In your best estimate, what percentage of your clients who request airline reservations to ask for a flight which offers the shortest travel time?

100% = every client asks for the shortest flight time  
0% = no client asks for the shortest flight time

- **Business Clients**  
  %

- **Leisure Clients**  
  %
Today, subsonic jet aircraft such as the 747 require approximately 12 hours to fly from Los Angeles to Tokyo. With a new generation supersonic aircraft, it will be possible to fly from Los Angeles to Tokyo in 4½ hours. The following questions will ask you to estimate the amount of fare surcharge that various passengers will be willing to pay for supersonic service.

(3a) Considering that the round-trip economy fare between Los Angeles and Tokyo is approximately $930, what do you feel is the maximum fare increase that economy passengers will be willing to pay per ticket for supersonic service on this route?

  Passenger traveling for business purposes $________.
  Passengers traveling for leisure purposes $________

(3b) Considering that the round-trip full coach fare between Los Angeles and Tokyo is approximately $2,038, what do you feel is the maximum fare increase that full coach passengers will be willing to pay per ticket for supersonic service on this route?

  Passenger traveling for business purposes $________.
  Passengers traveling for leisure purposes $________

(3c) Considering that the round-trip business class fare between Los Angeles and Tokyo is approximately $2,664, what do you feel is the maximum fare increase that business class passengers will be willing to pay per ticket for supersonic service on this route?

  Passenger traveling for business purposes $________
  Passengers traveling for leisure purposes $________

(3d) Considering that the round-trip first class fare between Los Angeles and Tokyo is approximately $5,118, what do you feel is the maximum fare increase that first class passengers will be willing to pay per ticket for supersonic service on this route?

  Passenger traveling for business purposes $________.
  Passengers traveling for leisure purposes $________
Please indicate whether you strongly agree (SA), agree (A), are undecided (U), disagree (D), or strongly disagree (SD) with the following statements.

(4a) Compared to subsonic passengers, supersonic passengers will have lower stopover costs, such as hotel rooms and meals

(4b) Due to shorter flight times, a supersonic aircraft will reduced the effects of jetlag on passengers

(4c) A supersonic aircraft will not create additional demand for transpacific air travel, and will pull passengers from existing subsonic flights

(4d) Although travel times are greatly reduced, supersonic passengers will have the same stopover costs, such as hotel rooms and extra meals, as subsonic passengers

(4e) Supersonic passengers to Asia will be affected by jetlag the same as subsonic passengers

(4f) A transpacific supersonic aircraft will create additional demand for transpacific air travel

(5) In which city is your travel agency located? __________________________

(6) For each travel category below, please indicate a "1" if the category is a primary sales focus of your agency, a "2" if the category is of secondary importance to your agency, and a "3" if your clients only occasionally purchase this service from you.

Domestic airline tickets ______
International airline tickets ______
Land packages ______
Cruise packages ______
(7) Do you feel that business and leisure airline passengers will choose a supersonic aircraft as their mode of transportation for trips to Asia? Why or why not?

(8) What characteristics do you feel a supersonic aircraft must have in order to be accepted by passengers in the Pacific market?

(9) Has this questionnaire been clearly worded and easy to understand? What recommendations do you have for improving the questionnaire?

Thank you for your help!
Appendix C: Pilot Study Cover Letter

James Starnes
1010 N. Swallowtail Drive
#406
Port Orange, FL 32119

June 25, 1993

John Q. Agent
ABC Travel
3000 5th Street
Los Angeles, CA 90505

Dear Mr. Agent:

As part of a master’s degree research project, I am conducting a survey to learn the attitudes of international airline passengers toward the speed of air travel across the Pacific Ocean. The National Aeronautics and Space Administration (NASA), together with Boeing Commercial Airplane Group and Douglas Aircraft Company, is developing technology for a commercial supersonic aircraft that will travel across the Pacific Ocean. With this supersonic aircraft, it will be possible for your clients to leave Los Angeles in the morning, conduct a full day of business in Japan, and return the same evening.

Your help is needed to find the preferences of both business and leisure travelers who travel across the Pacific Ocean. By taking a few minutes to reply to this short questionnaire, you will help to suggest the importance placed on flight time length when selecting transportation to Asia. Also, you will help to find the maximum level of ticket surcharge that your clients are willing to pay for this new supersonic service.

I understand the value of your time and greatly appreciate your help with this study. Since your name was drawn as part of a scientifically selected random sample representing the travel industry, your reply is essential to the accuracy of this survey. All replies are confidential and will be used only in combination with answers from other travel agencies in the Los Angeles area. Enclosed is a self-addressed, stamped envelope for your reply. Please respond by July 16, 1993. Thank you very much for your time.

Sincerely,

James Starnes
Appendix D: Questionnaire Cover Letter

James Starnes  
1010 N. Swallowtail Drive  
#406  
Port Orange, FL 32119  

August 20, 1993

John Q. Agent  
ABC Travel  
3000 5th Street  
Los Angeles, CA 90505

Dear Mr. Agent:

The National Aeronautics and Space Administration (NASA), together with Boeing Commercial Airplane Group and Douglas Aircraft Company, is developing technology for a commercial supersonic aircraft that will travel across the Pacific Ocean. This new aircraft will greatly reduce the travel time from the United States to Asia and the South Pacific. As part of a master's degree research project, I am conducting a survey to determine if such an aircraft will be accepted by passengers.

Your help is needed to find the preferences of both business and leisure travelers for supersonic air service. By replying to this short questionnaire, you will help to suggest the importance placed on flight time length when selecting transportation to Asia and the South Pacific. Also, you will help to find an acceptable fare surcharge that your clients would be willing to pay for this new supersonic service.

I understand the value of your time and greatly appreciate your help with this study. Since your name was drawn as part of a scientifically selected random sample representing the travel industry, your reply is essential to the accuracy of this survey. All replies are confidential and will be used only in combination with answers from other travel agencies in the Los Angeles area. Enclosed is a self-addressed, stamped envelope for your reply. Please respond no later than September 10, 1993. Thank you very much for your time.

Sincerely,

James Starnes
Appendix E: Responses to Question 5

5. Do you feel that passengers traveling for **Business** will choose a supersonic aircraft as their mode of transportation for trips to Asia and the South Pacific? Why or why not?

(1) Yes - less travel time away from home and business.

(2) Yes - if tied to a frequent-flyer program and reasonably priced.

(3) Yes - to eliminate flying time.

(4) Yes.

(5) People are always in a hurry and would like to get to their destination quicker.

(6) It is faster - if cost is same.

(7) Yes, if they are VIP's, management, business, and first-class business travelers. If the price was the same, I believe all business travelers would.

(8) The comfort and short flight time to be able to reach their business and complete it sooner.

(9) Yes, because of the shorter flying time.

(10) Maximize time on the ground, arrive in better shape.

(11) Yes: "Time is money."

(12) Yes - faster, shorter.

(13) Yes, if fare is reasonable - Time is money.

(14) Yes - because it provides the advantage of additional work time.

(15) Time element.

(16) Yes - less jetlag, less "wasted time", less boredom.

(17) Yes - less time lost in transit

(18) Yes - shorter non-productive business travel time involved.

(19) Possible - for obvious reasons of time.
(20) They will if the fares are reasonable or if companies feel the additional costs will be offset by additional benefits, such as increased business hours available to the traveler or increased traveler alertness.

(21) Yes - flights are boring, uncomfortable, and are only a means of getting there. Shorten the trip and they arrive more rested!

(22) Yes.

(23) Yes - Time! - Long, uncomfortable flights today.

(24) Yes, if time is a key factor and surcharge is not too great.

(25) Yes.

(26) Yes, provided cost is reasonable.

(27) Absolutely. The elapsed flying time would be the determining factor. Business travelers always want the most direct flight.

(28) Yes, time.

(29) Yes. Time is a most important factor for our business travelers.

(30) Yes - because of shorter flight time and more time to conduct business. It will be an incentive to fly more frequently.
Appendix F: Responses to Question 6

6. Do you feel that passengers traveling for Leisure will choose a supersonic aircraft as their mode of transportation for trips to Asia and the South Pacific? Why or why not?

(1) Yes - if not dramatic fare increase.

(2) No - cost factor.

(3) Yes - to eliminate flying time.

(4) Yes.

(5) Yes - people are always in a hurry and would like to get to their destination quicker.

(6) Faster. If cost is the same.

(7) Only if the price was equitable.

(8) Depending upon the price and how much time they have for vacation.

(9) They may or may not depending on their itinerary, if the supersonic destination coincides with theirs, the yes. If not, then no.

(10) Maximize time on the ground, arrive in better shape.

(11) Most would not. Leisure implies time to do whatever and stopovers are more desirable for leisure travel.

(12) Yes. Less time in the air.

(13) Only if the fare is the same. Leisure travelers are using their personal discretionary money, so price is more important than time enroute.

(14) Not necessarily, because the leisure clients, unless restricted to time, are generally not rushed to get to their destination.

(15) More comfortable, less time involved.

(16) Yes - if cost is reasonable. Less jetlag, less "wasted time", less boredom.

(17) Yes - at same rate as subsonic. Will arrive earlier.
(18) Yes - newer and faster mode of transportation allows more time at destination and usually more comfort enroute.

(19) Who knows?

(20) Upscale and/or status-conscious leisure travelers will choose this option. Budget-conscious travelers will always choose the least expensive option.

(21) Yes - flights are boring, uncomfortable, and are only a means of getting there. Shorten the trip and they arrive more rested.

(22) Yes.

(23) Only if slightly more expensive.

(24) I think my clients would be few, because most are very cost conscious.

(25) Maybe.

(26) Yes, provided cost is reasonable.

(27) Only if the fare is the same. But I find this to be a bit impossible.

(28) No - cost.

(29) If the cost is not too much more, our leisure clients probably would choose a supersonic aircraft.

(30) Yes, because passengers going on vacation in general do not like to sit on airplanes for long hours. They want to reach their destinations as fast as possible and enjoy more time sightseeing and visiting places.
Appendix G: Responses to Question 7

7. What characteristics do you feel a supersonic aircraft must have in order to be accepted by passengers in the Pacific market?

(1) Frequency, reasonable fares, comfort.

(2) Speed and convenient arrival/departure times.

(3) Comfort and reasonable fares.

(4) Price competitive.

(5) Safety, schedule, cost.

(6) Business travelers do like their frequent-flyer programs - also like comfortable seating and substantial food. Music and movies are important to leisure travelers.

(7) Seat size, leg room, size of overhead bin, ability to handle portable electronic devices such as lap-top computers.

(8) Comfortable seating, pleasing decor.

(9) Reasonable surcharge over subsonic aircraft.

(10) Low fares.

(11) Comfortable and dependable.

(12) Comfortable seating, good leg room, good meal service, and ample walking area for stretching.

(13) Be safe, comfortable.

(14) Reasonable cost, safety, good seat pitch and leg room.

(15) Be part of major airline.

(16) Affordability and logical itineraries.

(17) New, excellent service and standards they expect now.

(18) Affordability.
(19) Increase the comfort of the seats, make meals lighter, increase size of bathrooms, 
make arrivals after 5 p.m. so they can have a good nights rest before starting a tour 
or taking care of business the following day.

(20) Roominess, convenient schedule, first-class type pre- and post-boarding, luggage 
handling efficiency.

(21) Safety.

(22) Speed, reasonable surcharges. People are intrigued with new modes of travel, such 
as the Concorde.

(23) Impeccable safety. Low fares.

(24) Good service, which is pretty much the name of the game in this business. Also, 
flights that leave on time.

(25) Service.

(26) Comfortable seating, good scheduling, competitive fares.

(27) Comfortable seats, wider space in between seats, more leg room than the 747, noise 
free.