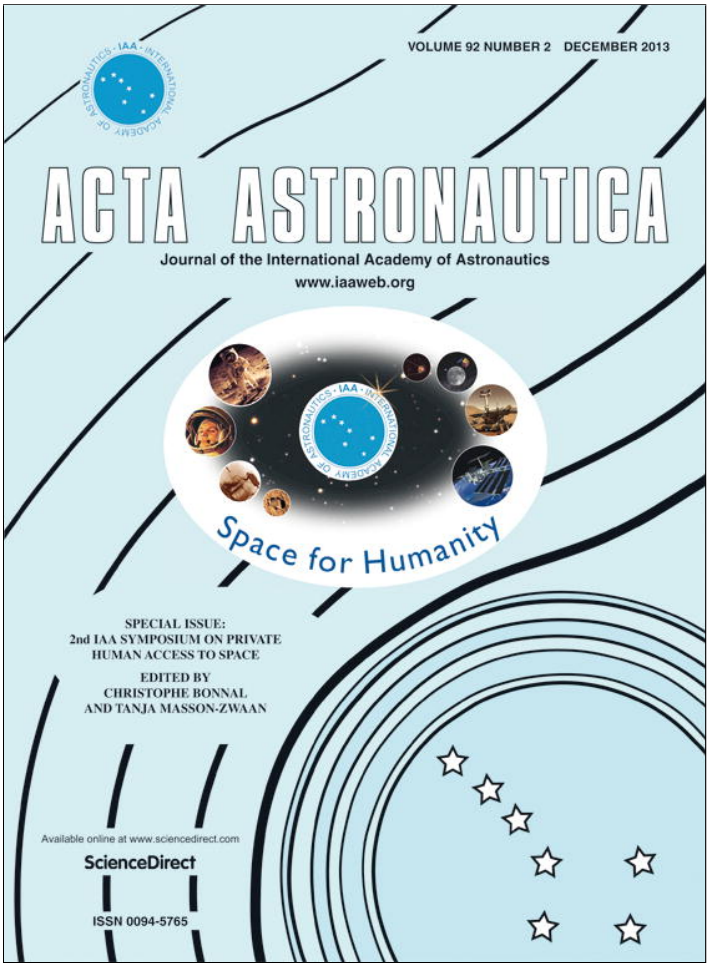
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Point-to-point people with purpose—Exploring the possibility of a commercial traveler market for point-to-point suborbital space transportation

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ABSTRACT

An argument was made at the First Arcachon Conference on Private Human Access to Space in 2008 [1] that some systematic market research should be conducted into potential market segments for point-to-point suborbital space transportation (PtP), in order to understand whether a commercial market exists which might augment possible government use for such a vehicle. The cargo market potential was subsequently addressed via desk research, and the results, which resulted in a pessimistic business case outlook, were presented in [2]. The same desk research approach is now used in this paper to address the potential business and wealthy individual passenger traveler market segment ("point-to-point people with purpose"). The results, with the assumed ticket pricing, are not encouraging.

1. Introduction

We differentiate two sub-categories of those commercial human passengers of point-to-point sub-orbital space transportation who are traveling with purpose (as opposed to only doing it just for the experience), such that in the case of the *business* traveler, it is assumed that the fare is paid by his/her organization, and business at the destination is assumed to be the motive for the travel, whilst for the *wealthy individual* sub-category, the passengers are assumed to pay their own fare, and there is no assumption about what they do at their destination. There is no analysis in this paper about another category of potential human passengers of a PtP vehicle, namely the space tourist category, and the associated proportion of sub-orbital space tourists who might pay a premium to extend their experience by traveling, maybe halfway round the world, point-to-point. Ultimately, some prime market survey research is needed to arrive at a definitive answer to the possible commercial viability of this form of transportation, but meanwhile significant headway may be achieved using available published data and desk research and analysis. All the analysis in the paper uses a common set of basic passenger air travel data, which has been assembled for the convenience of researchers as a separate Appendix to this paper (and which contains its own list of reference sources).

2. Potential corporate-funded business travelers

We know quite a bit about business travelers and the price elasticity of their flight decisions. From the Appendix, we can see that the proportion of first class air travel has been declining. It used to be 5% of the total in the 1980s, dropped to 2% of the total by the 1990s (see Appendix section 2.6), and is now even much less than 1% (8300 seats/day from Appendix section 3.2=3,029,500/yr, compared with 1,656,000,000 from Appendix section

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2.3, viz 0.2%). Some airlines, eg Qantas, are removing first class entirely. The vast majority of air travelers now fly coach/economy/tourist class, with business class passengers representing about 20% of the total (see Appendix section 2.6). As much as half of a carrier's total revenue is generated by so-called premium flyers, which as we have seen nowadays by default means business class travelers. During the current economic downturn, moreover, some companies are requesting their flying executives to trade down to coach class, and so clearly this category of flyer is price-elastic. And, from the airlines' perspective, they are concerned to keep the percentage of premium flyers as at present, or ideally higher, so in this state of tension, price is clearly a key variable.

What kind of price premium is associated with business class air travel? The data (see Appendix Section 2.5) suggests a range of 15–44% ($782 × 2 = $1564; $1800 represents 15% premium; $2254 represents 44%) above the coach class airfare charges for the same journey. In return for this price premium, business class travelers generally have more legroom and space in general, and moreover can expect a better meal service, particularly on longer flights. The small proportion of passengers who still fly first class (0.2% of the total) may pay a premium of upto 6 × the regular fare for the same journey (see Appendix Section 3.3). For that premium, even more space is provided—enough these days to provide beds, together with finer meals and service.

We also have Concorde data to provide results for even higher price points. The data shows that, while Concorde was flying (between 1972 and 2003), 150,000people/yr took advantage (see Appendix Section 4.5). This amounted to 0.01% of all air travelers (150,000 c.f 1,656,000,000 from Appendix Section 2.3; although if we focus on the main Concorde routes of JFK–LHR and CDG–JFK, the figure becomes 4.5%). The premium they paid for the flights was approximately a further 2 × the first class air fare ($11,000 from Appendix Section 4.6c.f $5,000 from Appendix Section 3.3). For this premium they obtained a quicker flight, and supreme service, although the cabin itself was relatively cramped, with tiny windows, and passengers were limited in the amount of luggage they could take with them.

3. Potential personally-wealthy travelers

Not all premium air travelers are flying for business purposes. In the case of Concorde, we have a data point (see Appendix Section 4.5) that indicates that 80% were business travelers, and therefore by default we may assume the remaining 20% were independently wealthy individuals. Among this category, we might expect to find TV or movie stars, professional tennis and golf players, Formula 1 drivers, etc. [3] provides some insight into these travelers, including their need for a special terminal and exceptional service. For our purposes in this paper, however, it is sufficient to make the conservative assumption that their flight decisions are not price sensitive. We do not need to know whether they conduct business or pleasure at their destination.

4. Point-to-point pricing

To provide a valid analysis of the potential for a commercial traveler market for point-to-point suborbital space transportation, we need to know the likely range of seat prices for such a service. The price per seat is likely to be of the same order of magnitude as the price per seat for a sub-orbital space tourist, which is currently announced to be $200,000 (by Virgin Galactic) or $100,000 (by XCOR). In fact, the price will probably initially be higher than the basic sub-orbital price, because the providers will seek to charge a premium above the basic sub-orbital spaceflight charge to reflect the more extensive experience provided (although one perhaps overly optimistic potential provider [4] nevertheless predicts eventual prices of as low as $2000 when the markets and technology have matured). Sub-orbital point-to-point space transportation has more in common with orbital space flight (requiring complex heat shields, etc.) than it does with sub-orbital space tourism, at least with regard to the level of complexity and the energy demands of the technology, and even the more sophisticated ground operations. So, also from a cost perspective, we must expect that prices will initially need to be higher than those in place for the suborbital space tourist operations, such as those being offered by Virgin Galactic from Spaceport America. The price of seats on Soyuz for orbital flights has been in the range $20–50 M, and SpaceX has indicated that it would charge about $20 M per seat on their Dragon spacecraft for orbital missions. Let us therefore conclude that a seat on a point-to-point suborbital space transportation flight (say from London to Sydney) will probably initially have to be at least in the range $100,000–300,000 in order for the operators to have a chance to recover their operating costs and some share of their investment costs. The $100,000 figure represents, for comparison, about 10 × Concorde prices. One reviewer has suggested a range $200,000–5 million per seat, based at the upper end on the hoped-for potential to reduce Soyuz seat prices by a factor of ten. This is of course an area of uncertainty, so we keep this recommendation in reserve, as a way of deriving a downward sensitivity to the results.

5. Analysis

So what kind of market can we expect, given the data presented in this paper thus far? We can derive an effective price elasticity of demand curve, to help us understand the potential. We saw that 20% of passengers would pay a 15–44% premium to travel in business class, and that less than 1% of passengers would pay the 6 × premium to fly first class. The analysis of the Concorde data shows us that only 5% of those passengers who would normally be flying first class would opt to use Concorde, with its 2 × premium beyond first class seat prices (150,000/yr from Appendix Section 4.5 compared with 3,029,500/yr — see Section 2 above).

At the assumed price range of PtP seat prices, the premium over Concorde prices would be a further 10 × to 30 × (see comparison price of $10,000 in Appendix Section 4.6). This price of course represents a premium over regular coach class air fares of about 50 ×. How many would pay this premium? In the absence of actual market survey data, we can reasonably guess that, for the price-elastic or the business traveler Concorde-flying category, it is unlikely that more than 5% of the former Concorde class passengers would be prepared to pay such an additional premium, even though they value their time very highly ([7.3] quotes pounds 3000/h for senior executives). That is because this is the same proportion of 1st class passengers who opted for Concorde, when it was available. After all, the data shows that ticket pricing on the supersonic transport is very sensitive and Concorde pricing could not be set high enough to recover all of the operating costs, let alone any of the development investment funds, without losing significant numbers of passengers, and only two routes were still operating by the time the service finally ended (see Appendix Section 4.3). Using the 5% of Concorde assumption leads to a global price-elastic market for the point-to-point suborbital space transportation service of 7500passengers/yr (150,000 from Appendix Section 4.5 × 5%). Given the assumptions we have made on likely price level of point-to-point suborbital space transport seating, this translates to a market of corporate-funded PtP business travelers of only 20passengers/dy worldwide. If we had opted for $5 million as the upper bound on price, as one reviewer has suggested, this result would more likely had been 0 passengers/dy (for these price-elastic commercial passengers).

Fig. 1 below shows a summary of this airline passenger price-elasticity data as presented in this analysis. In the sensitivity case where $50 million is chosen as the likely seat price, the premium axis would need to be extended substantially to the right because the premium would then be 500 × even above the Concorde price.

We need to add in, however, that portion of Concorde passengers that is assumed to be not price-sensitive. This is the category we have described above as "personally wealthy passengers". They may be traveling for business purposes; they may not—it makes no difference to us in this calculation. We have seen (Appendix Section 4.5) that this grouping represents 20% of those flying the supersonic transport. If we assume that all of them would use the PtP service, that would add another 30,000passengers/yr (20% × 150,000), or 80/day. Just as an independent check, we note that 30,000 independently wealthy people per year represent about 1/2% of the world total of millionaires.

The combined global passenger total for "point-to-point people with purpose" from this analysis is therefore 100/day (20+80), given our assumptions on seat pricing, and we noted that the mix would have completely switched over from Concorde flyers, who were 80% business travelers and 20% independently wealthy (Appendix Section 4.5) to PtP vehicle passengers, where the ratio will be 20% business travelers, and 80% independently wealthy. And of course, as a sensitivity exercise, using an extreme high price of $5 million per ticket as suggested by a reviewer as an upper limit would reduce this figure to at most 80/day in total (0+80), and probably much less, because our assumption that all of the personally wealthy passengers would use the PtP service at such a price is surely optimistic. So the sensitivity/uncertainty in this result is about 100passengers/day ± 50passengers/day.

It is therefore unlikely that a commercial business case can be closed, in the absence of non-commercial (i.e government/military) funding, with such a low potential market. Other considerations would further reduce the number—e.g. the global numbers would have to be split into the various routes (assuming that ground infrastructures could be put in place to minimize delay on the ground before and after flight at the origins and destinations), and if there were more than one provider the competition would further erode the potential for a single operator. In practice, a fleet has to be established which is large enough to enable a repair and maintenance schedule to be operated. This also has implications for the sizing of the vehicles. Furthermore, possibly some potential travelers would be unwilling to experience the higher than

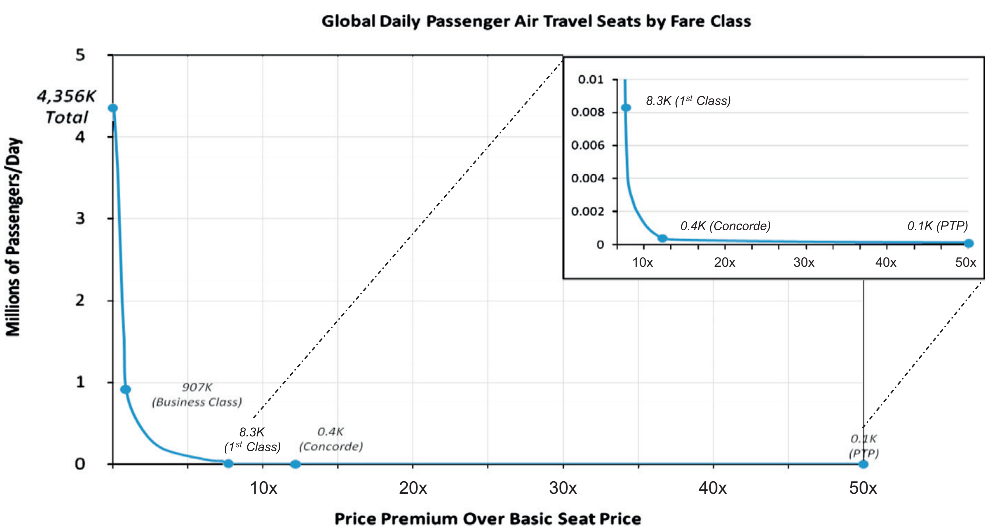

Fig. 1. Price elasticity of demand for premium air travel (Credit: Webber/Andrew Willis/SEI).

normal g-loadings that would be a consequential part of the PtP technology, thus further reducing the market opportunity. It would also be critical to set the daily timings of flights so as to achieve the maximum advantage of the speed offered by the PtP vehicle; if someone could fly a few hours earlier on a regular flight, then much of the advantage of PtP would be obviated. An alternative approach might be to have a small vehicle, and instead of operating it as an airline, simply fly it on demand, which would require wholly a different kind of logistical and business operation. It seems clear from this analysis, therefore, that only a small vehicle could have any chance of operating a PtP commercial passenger travel service successfully.

6. Conclusions

The total global market (all routes) for business and wealthy individual passengers for a point-to-point suborbital space transportation service ("point-to-point people with purpose"), given the assumptions on pricing laid out in the paper, is only about 100passengers/day ± 50, and at these volumes only small vehicles, possibly flying on an on-demand basis (like business jets) would have a chance of operating commercially. The commercial viability of a hypersonic vehicle capable of providing point-to-point sub-orbital space transportation would seem to be marginal, at best, given the findings of this paper related to passengers, and the previous referenced paper [2], on commercial cargo. There may, however, be a market for space tourists who would fly in the vehicle just for the experience, but this market has not been assessed in the paper.

Appendix. Air transportation passenger data

1. Introduction

This is a database of air travel information collected from a number of sources listed in Appendix Section 5. The database represents raw data and sometimes different sources provide differing values. This Appendix has been compiled to provide a common reference point for analysis of potential markets for air and sub-orbital point-to-point transportation.

2. Passenger air travel totals

2.1. Fleet sizes				*Ref.*
Yr 2000 World airline fleet turbojets	16,405			5.5
Yr 2000 World airline fleet turboprops	7730			5.5
Yr 2000 US airline fleet turbojets	5956			5.5
Yr 2000 US airline fleet turboprops	1475			5.5
2.2. Routes				
1996 LHR–JFK	2,500,000			5.2
1996 LHR–LAX	1,500,000			5.2
1996 LHR–SFC	1,100,000			5.2
1996 FRK–JFK	1,000,000			5.2
1996 LHR–CHIC	1,000,000			5.2
1996 AMS–JFK	900,000			5.2
1996 LHR–IAD	900,000			5.2
1996 ROME–JFK	850,000			5.2
1996 CDG–JFK	800,000			5.2
1996 LHR–NEW	700,000			5.2
1996 LHR–SYD	700,000			5.8
Yr 2000 Avg domestic US trip length	833 miles			5.5
Yr 2000 Avg international trip length	3319 miles			5.5
9 airlines fly the JFK–LHR route				5.18
2.3. Passenger seats				
Yr 2000	Total passenger seats	1,656,000,000		5.5
Yr 2000	International passengers/flight	240–270		5.2
2.4. Revenue seat miles (or RPM)				
Yr 2000 Seat miles (global)		2,646,000,000,000		5.5
Yr 2010 Seat Miles (US carriers)		778,378,546,000		5.20
2.5. Prices				
JFK–LHR	Coach/economy	one way	$782	5.18
JFK–LHR	Business class	round trip	$1800	5.17
JFK–LHR	Business class	round trip	$2254	5.19
2.6. Coach/business/first class splits				
Proportion first class 1980s			5%	5.2
Proportion first class 1990s			2%	5.2
Premium class (1stplus business), 2009			20%	5.21
2.7 Airline finances				
Yr 2000 World passenger revenues		$248,940 M		5.5
Yr 2000 US revenue share		39%		5.5
Yr 2000 World flight operations costs		$98,790 M		5.5

Yr 2000 World M&O costs		$33,710 M	5.5
Yr 2000 World depreciation and amort		$20,780 M	5.5
Yr 2000 World operating profit (3.3%)		$10,700 M	5.5
Yr 2000 Fuel cost as percent of ops		14%	5.5
	Crew costs for LHR-SYD return flight	Pounds 55,300	5.8
	Avg load factors	68%	5.2
	Yr 2010 avg load factors (US)	81%	5.20
	Boeing 747 unit cost	$250–300 M	5.16
	Average airliner life	40–50/yr	5.2

3. First class air travel data

3.1. Routes

Top six routes for first class travel:			5.12
JFK–LHR	737 seats/day		5.3
CDG–TYO			5.12
LHR–LAX			5.12
LAX–TPE			5.12
JFK–CDG			5.12
BOS–LHR			5.12
3.2. Passenger seats			
Transatlantic eastbound	1874 seats/day		5.3
Transatlantic westbound	1855 seats/day		5.3
Transpacific eastbound	2285 seats/day		5.3
Transpacific westbound	2283 seats/day		5.3
3.3. Prices and premiums			
2006 First class JFK–LHR fare (one way)		$5,000	5.12
2006 Average JFK–LHR fare (one way)		$800	5.12
One way ticket price % of round trip (Air France)		75%	5.13
First class round trip price for 6000–14,000 km		$12 K - $15 K	5.13
Total outlay (incl lost time) LHR–SYD		Pds 71K -92K	5.8
First Class Revenues JFK–LHR		$1.25B	5.3

4. Concorde data

4.1. Operating period

Years of passenger service:		27	5.14
Concorde rollout		Dec 1967	5.14
Concorde first prototype flight		2 March 1969	5.14
Concorde first revenue service		21 Jan 1976	5.2
Concorde last revenue service		24 Oct 2003	5.14
Concorde last flight (disposal)		26 Nov 2003	5.14
4.2. Fleet size			
Total build	20 aircraft		5.14
Development and pre-production	6 aircraft		5.14
Production (7 for BA, 7 for AF)	14 aircraft		5.14
4.3. Routes			
The following is the complete list of scheduled routes (going in both directions), although they were not all operating simultaneously:			5.2
London–Bahrain	2x weekly		5.2
Paris–Dakar-Rio	2x weekly		5.2
Paris–Azores–Caracas	1x weekly		5.2
London–Washington	3x weekly		5.2
Paris–Washington	Daily		5.2
London–New York	Daily		5.2
2 × daily	2x Daily		5.14
Paris–New York	Daily		5.2
2 × weekly	2x weekly		5.14
London–Bahrain–Singapore	3x weekly		5.2
Paris–Washington–Mexico	?		5.2
London–Washington–Dallas	3x weekly		5.2
Paris–Washington–Dallas	2x weekly		5.2
London–Washington–Miami	3x weekly		5.2
London–Tokyo	"less frequently"		5.14
London–Melbourne	"less frequently"		5.14
Note: Eventually only 2 routes were operating (each way) from 1998 onwards, namely London–New York, and Paris–New York.			5.2
Charter flight operations began in 1982			
4.4. Fuel consumption			
Concorde average fuel consumption	6770 gal/h		5.14

Concorde avg consumption per passenger	157 gal	5.14
Comparison avg 747 consumption per pass	57gal	5.14
Concorde consumption per pass per flight	1 t	5.2
4.5. Passenger seats		
Total concorde passengers (1976-2003)	2.5 million	5.4
Average concorde passengers/yr	150,000	5.4
Average seating per aircraft	100 seats	5.14
Proportion who were business travelers	80%	5.15
Proportion who were repeats	80%	5.15
4.6. Prices/premiums		
Yr 2000 seat price	$9300	5.14
Yr 2003 seat price (one way)	$6300	5.15
Yr 2003 seat price	$11,000	5.4
4.7. Concorde finances		
Concorde development costs	$7.7B(1980)	5.11
Per aircraft development cost	$500 M	5.2
Aircraft price	$160 M	5.11
"None were ever sold"		5.2
"Free to BA and AF, so that the ticket prices merely covered the marginal costs of crew plus fuel plus part of the maintenance"		5.2
4.8. Other factors		
The following other factors were recorded as being relevant to the operation of a supersonic airliner:		
Sonic boom		5.10
General noise level		5.10
Limited luggage capacity		5.14
Carbon emissions		5.7
Time of day limitations affecting utilization rates		
Special ground processing, limo services, etc.		

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