

“Filling in Some Gaps”

Executive Summary of

The Adventurers’ Survey of Public Space Travel



Derek Webber and Jane Reifert

September 2006

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1. Introduction

During August and September 2006, a new survey into public perceptions of space tourism was conducted jointly by Derek Webber of Spaceport Associates and Jane Reifert of Incredible Adventures. The survey was conducted on-line via the web site of Incredible Adventures, and 998 responses were obtained and analyzed. The previous major survey into this field was the Futron/Zogby Survey (Ref 1), and this was completed four years ago. In the intervening time there have been major events in the field, including the winning of the X-Prize by Burt Rutan's SpaceShipOne, and the launch of Bob Bigelow's Genesis 1 orbiting hotel prototype. At the time of the earlier survey, the concept of space tourism was still unproven. The new survey reflects opinions now that the industry is near to launch, with Virgin Galactic and Rocketplane Kistler both preparing for first passenger operations in around 2008.

Apart from picking up any changes in perception due to the passage of time, this survey also addresses new questions that were not included in the earlier study, and also delves deeper into the detail of the space tourism experiences that people want to enjoy, hence the title: Filling in some Gaps. Answers on these matters will help the new space tourism operators tailor their experiences more closely to the stated requirements of their clients.

An important caveat must be made at this point. The original Futron/Zogby survey was carefully conducted in a statistically valid and unbiased way in order to make it possible to derive credible forecasts of demand. The current survey has opted instead to go directly to people who are *a priori* biased in favor of adventure holidays. That is why it is called The Adventurers' Survey. So, the findings cannot be scaled up in any rigorous way to provide statistically valid forecasts of demand for the population in general. But, using this technique provides instead very valuable input from those most likely to want to undertake the experience, and who understand, and are willing to overcome, the risk element in undertaking a space tourism adventure. These opinions therefore are very important to those engaged in designing space tourism experiences, and the number of responses was enough to ensure that this sample is representative of all Adventurers who access the Incredible Adventures web site.

For the record, the respondents were 91% male, came from all over the world (although 63% were from the US), and 94% were aged under 60 years. Physically, they are rather large with 36% being greater than 6 feet and 28% weighing over 200lbs. Only 14% were millionaires. They had all done some kind of risky adventure experience in the past, such as mountain climbing or skydiving.

2. The Space Experience Package – Filling in some Details

Three aspects of space tourism were explored that had not been fully developed in the earlier work, and where the potential client perception could provide valuable input as the space tourism operators begin to put their business plans and operations together. They concern training, duration of orbital experiences, and the design of the new space vehicles. Of course it may not be possible to always satisfy these preferences, especially in the early years of operations, but it is important nevertheless to know the current *a priori* preferences of the potential public space travelers.

TRAINING

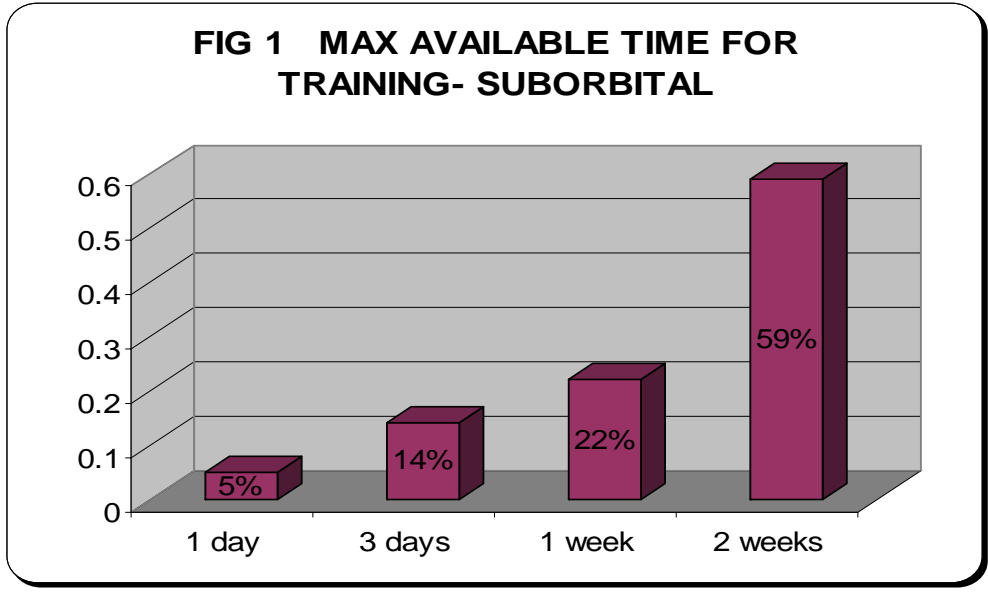
Respondents were asked:

“What is the most amount of time you would be willing to devote to a Suborbital space adventure?”

In asking this question, there was the intent to explore how far the potential tourists would be willing to go in order to be trained for what ultimately is approximately a one hour experience. The exact description of the experience given to the respondents was:

“This is an adventure where you go straight up into space (ie above 60 miles high), spend about 5 minutes in zero-g, then descend straight back again. You see black sky, the curvature of the Earth’s horizon, and the view for hundreds of miles in every direction. This flight is like the first American spaceflight by Alan Shepard.”

The aggregate response is provided in Fig 1, and we note that there is no problem with public willingness to undergo training, **with 59% even willing to spend two weeks training** for this one flight opportunity.



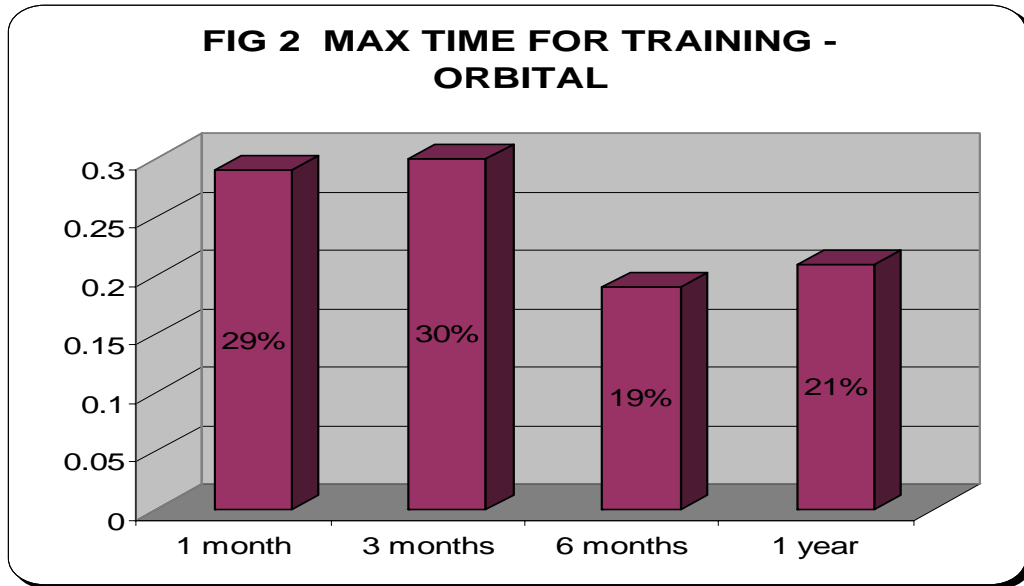
The training duration will be very much greater for the orbital space tourism experience, so respondents were asked about this as well. The exact question was:

“What’s the most amount of time you’d be willing to devote to preparing for and completing an Orbital Space Mission, including medical checks, training and the flight itself?”

The exact description of the orbital space tourism experience was:

“This is an adventure where you go into orbit and keep circling the Earth every 90 minutes. You will see all the countries and oceans below you, and will experience a sunrise and sunset 16 times each day, and be in zero-g the whole time. This flight gives you the same views and experiences as today’s Shuttle astronauts. In some of the flights, there will be docking with a space hotel. In others, you will remain in the spaceship that brought you!”

The aggregate results are provided in Fig 2. To get at the duration of the training element from these results, it is necessary to subtract the mission duration itself (and this amount will be discussed in the description of Fig 3 below). We see that **59% indicate a maximum acceptable duration of 3 months for training**, with 41% willing to undergo the current period of 6 months or more. Clearly, this gives an indication of the changes that will be needed once the early orbital space tourists have completed their adventures.



Ref 4 provides some discussion and perspective on the history of training and medical qualification of space travelers to date.

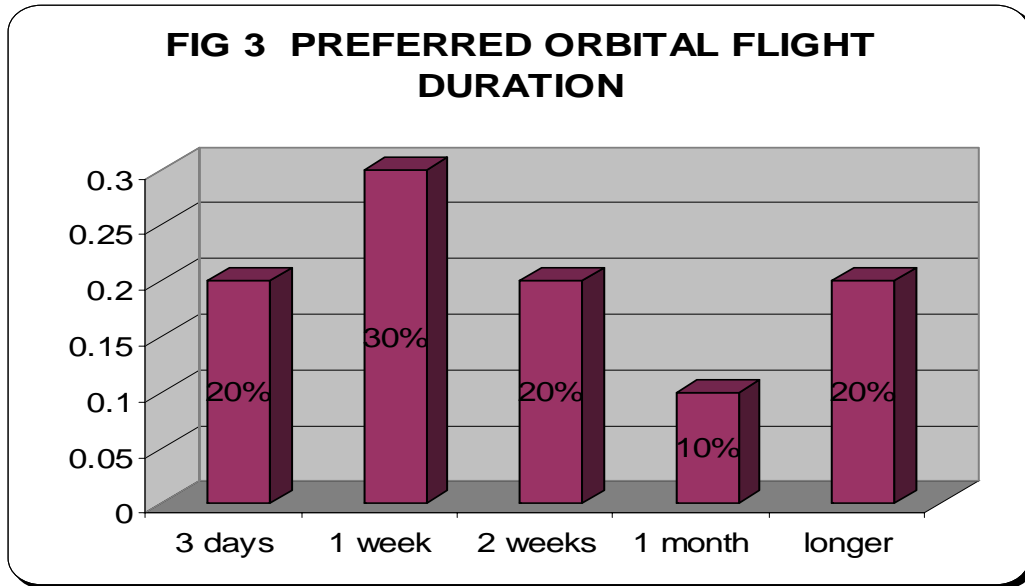
DURATION OF ORBITAL SPACEFLIGHT

An important question that has not previously been asked of potential orbital space tourists is about the duration of their flight. Clearly there are balancing requirements for tourists between wanting to have the maximum time in orbit for the price of the ticket, versus possible health affects of being too long in zero-g and the need to return to their everyday lives and families. From the viewpoint of the manufacturer and operator, there are limitations imposed by, amongst other things, the amount of consumables that can be carried.

The way the question was posed was:

“Going Round and Round – How long would you want to be in orbit? (Please click on the maximum time you’d want to be in space).”

Fig 3 shows the resulting aggregate response, and the good news from the point of view of the manufacturer and operator is that **70% will be happy with two weeks or less.**



PREFERRED SPACECRAFT ARCHITECTURES

Potential customers have not been asked so far about any preferences in the way they would want to get into space. The industry is so new that there are not many options in any event. However, new operators are still designing their offerings, so any input in terms of market preferences should prove useful. At present, the only ways the general public has seen astronauts and/or tourists going into space have been via Soyuz in Russia, or via the Shuttle or Mercury/Gemini Apollo or SpaceShipOne in the US. They have not yet seen the Rocketplane approach demonstrated, or several other system architectures involving balloons, helicopter type landings, etc. In order to obtain some generic data that would be useful, the architecture modes were separated into take-off and landing, and the types of approach were limited to three in each case. Ref 5 provides some perspective on different design architectures. For the take-off architecture, the following three options were offered:

“Vertical takeoff This technique is like a standard rocket launch, and was used historically by all US astronauts starting with Mercury and Apollo and including Shuttle flyers today.”

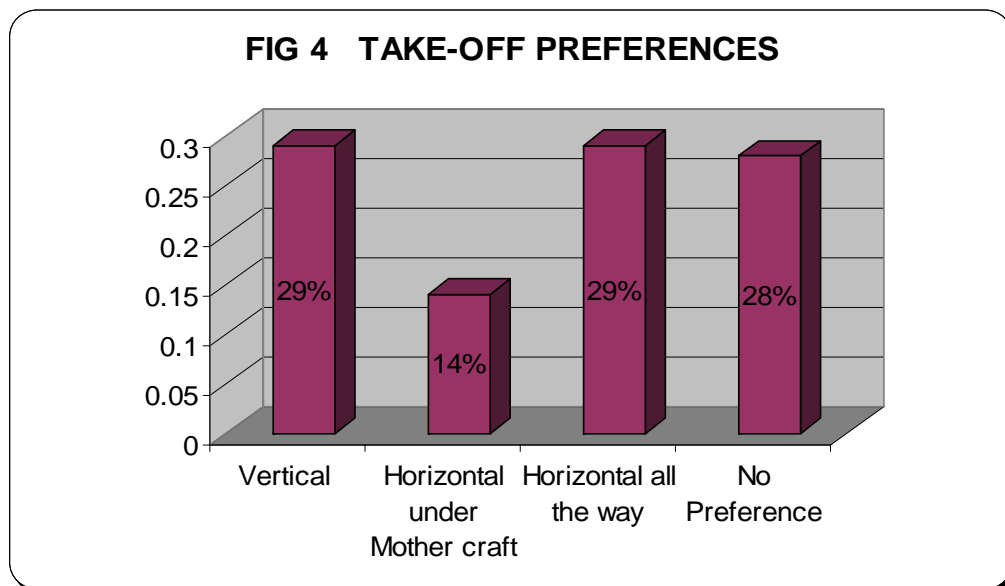
“Horizontal Takeoff Suspended under a Mother Craft This technique was used historically by early flyers like Chuck Yeager in the X-1 and more recently by the SpaceShipOne team when they won the X-Prize in 2004”

“Horizontal Takeoff in an aircraft that goes all the way to space This technique has not yet been demonstrated, but it is being developed by the Rocketplane company in Oklahoma. The aircraft takes off using conventional jet engines, and transitions to rocket engines when it reaches altitude.”

The respondents were offered options of choosing 1st 2nd and 3rd choices of favorite mode, and the specific question was framed as follows:

“There are essentially three ways you can leave the planet. You can blast straight up in a rocket. You can hitch a ride on another craft up to a certain altitude and then launch horizontally from the sky. Or, you can take off horizontally in an aircraft that goes all the way to space. (State your choice).”

The resulting aggregate results are in Fig 4. We note first of all that there are a rather significant 28% who have no preference, stating “I honestly don’t care how you get me there, I just want to go”. However, amongst those who do have a preference, **there was only half as much interest (14%) in a take-off in a spacecraft suspended under a mother craft, compared to each of the other two alternatives (at 29%)**. On the face of it, this is a rather surprising finding, given that the SpaceShipOne technique derived much publicity during the X-Prize flights, and furthermore this is the technique that Virgin Galactic is planning to use for its inaugural space tourism service. Further research of the raw data may give some insight into this unexpected result.



The respondents were also given an opportunity to comment on architectural modes of landing from their space tourism experience. For simplicity, only three alternatives were offered for the respondents to rank in order of preference. The exact descriptions used on the survey for these three modes were:

“Vertical Landing in Water This technique was used historically by the early US astronauts from Mercury to Apollo.”

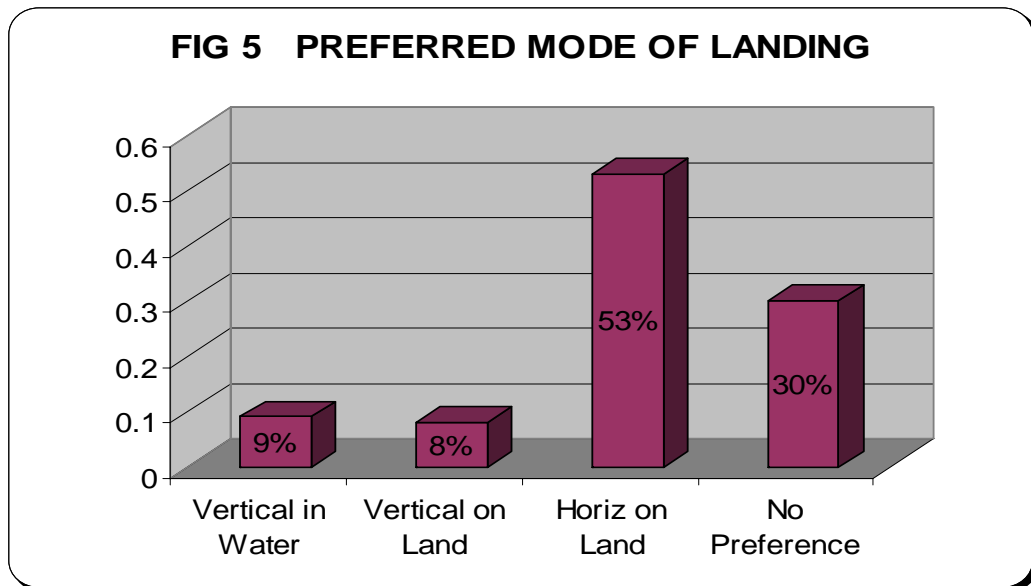
“Vertical Landing on Land This technique has been used consistently by all Russian spacecraft from Vostok to the present day.”

“Horizontal Landing on Land This technique is used by today’s Space Shuttle and also by the SpaceShipOne team.”

The exact question was framed as below:

“There are different ways of landing. Please let us know what you’d like best by ranking the choices in order of preference.”

The resulting aggregate results are shown in Fig 5. Again, we observe that as much as 30% have no particular preference, indicating in their replies that “I honestly don’t care as long as you get me back OK.” However, amongst those who did express a view, there is a **six-fold preference for a horizontal landing on dry land (at 53%) versus either of the vertical landings** (which, it should perhaps be noted were illustrated as parachute landings in the survey descriptors), **which come in at only 9%**. This data is real. We have almost 1,000 responses in total, and over 500 want the horizontal landing and only 90 want a vertical descent. Again, further analysis of the raw data may eventually provide some explanation for these findings.



3. Some New Angles

Some matters were not given adequate, or indeed any, treatment in earlier surveys. The Adventurers' Survey therefore took the opportunity to ask of potential space tourists their opinion on spaceports, EVA, space hotels and the idea of corporate space tourism.

SPACEPORTS

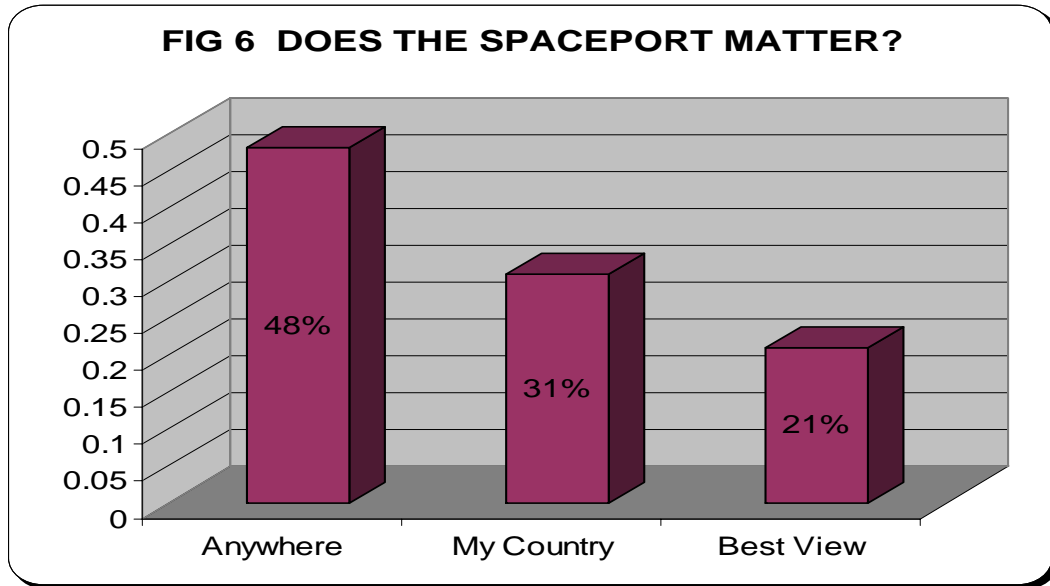
A number of US states are competing for the business that spaceports will bring to their regions once space tourism becomes operational. It seems unlikely that they all will be successful. The success or otherwise of a spaceport venture will depend on a great many variables (not least of which is where the tour operators decide to base their operations), but it was considered to be a useful opportunity to explore the extent to which the opinions of the space tourists themselves would have a significant bearing on the outcome. Ref 3 provides some background to this discussion.

The question was framed in the context of *suborbital* space tourism. This was because the sub-orbital space tourism flights will be the first to happen in quantity, and moreover for a sub-orbital experience, the location can have a major impact on the view obtained from space.

The exact question asked was:

“Spaceports-How much do they matter? Does the location of a suborbital spaceport matter? Spaceports are the locations where space flights will begin and end.”

The resulting aggregate findings are presented in Fig 6, from which we learn that **48% of the respondents would be prepared to go anywhere**. Another 31% would go anywhere, provided it is in their country (and remember 63% of them are from the US). Only 21% stated an interest in “the best view”. It is possible that they have not yet fully thought about the difference that the location of the launch site makes to the experience.



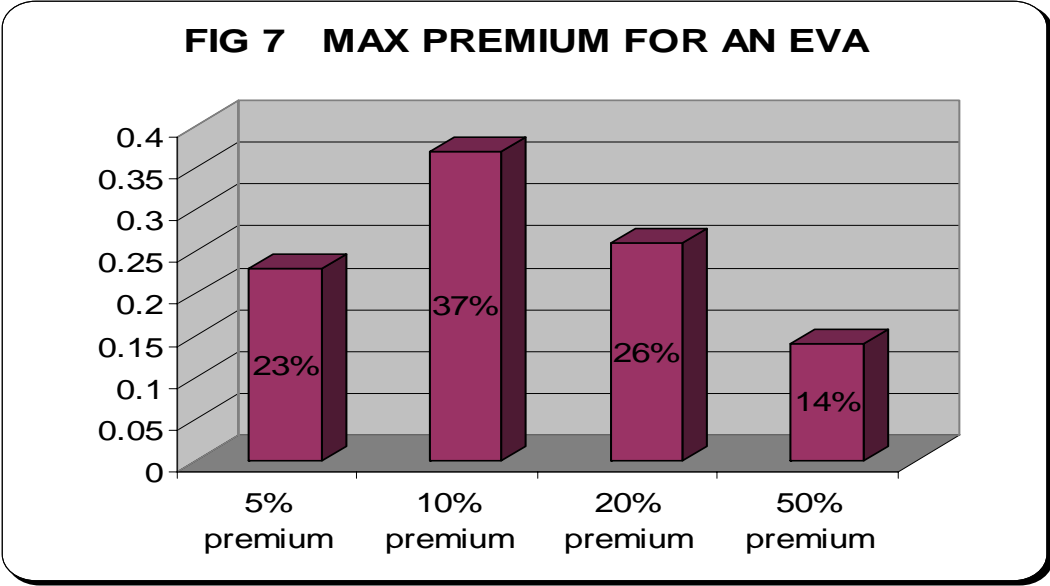
Spacewalking/EVA (Extra Vehicular Activity)

A question was posed to determine what interest there was in EVA, and the extent to which space tourists would be willing to pay more for that option. The question was framed in two parts; the first part addressed whether respondents were interested at all, then the second part asked the incremental price question. For simplicity, no indication was given in the question that training periods would probably be extended for this option, and if it had been, the findings might have been somewhat lower than those recorded.

The specific formulation of the question was:

“EVA (Extra Vehicular Activity) - That’s astronaut talk for “Going outside the spacecraft to move around” - Would you like an opportunity to float freely in space outside the spacecraft? If so, how much more would you pay, on top of the flight cost, to take a space walk? (Please click on the maximum amount).”

88% of the respondents indicated an interest in EVA. Of these, the price increment they would be willing to pay is shown in aggregate in Fig 7. We see that **85% would pay up to 20% for this opportunity.** 14% would pay even more.



HOTEL/SPACE STATION

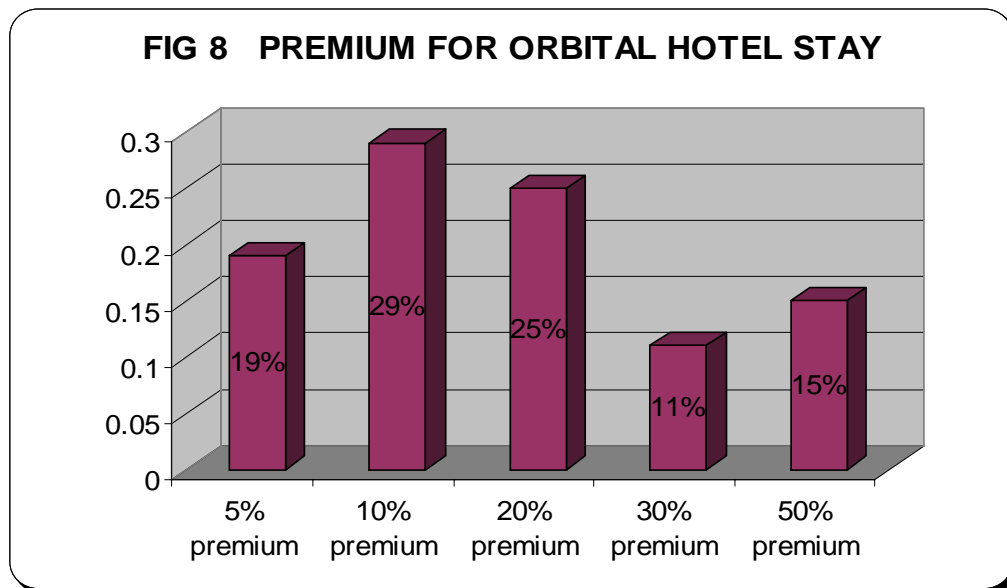
In the early years of space tourism there has been some perceived conflict between the joint occupation of governmental space stations by on the one hand government working astronauts and researchers, and on the other by paying public space travelers. When the space station Mir was operating, it was controlled by the former Soviet Union and there was no problem for the first tourists to go there. However, once the International Space Station, ISS, became the destination, and it continues to be a construction site, the problem was raised. Nevertheless, all space tourists from Denis Tito onwards have used the ISS as their orbital destination. As a destination for an orbiting space tourist, the ISS is not however ideal. It is, after all, a research laboratory still under construction. For this reason, Bigelow is developing his own range of private orbiting space hotels, and has launched a prototype earlier this year. There is of course the possibility of going into orbit for only a few days and remaining in the spacecraft the whole time from launch to landing. This might be uncomfortable in say a Soyuz spacecraft, but of course many early astronauts spent as long as 2 weeks in precisely that mode. So, it is important to explore the attitude of the potential space tourist to these options. Of course, if a space hotel is to be the destination, there will need to be a price increment to pay for the technology development and the operating costs.

The precise formulation of the question to the respondents was:

“How important is a stop at a space hotel or space station? In other words, is a destination in space important or are you happy staying in a spacecraft the whole mission?”

The perhaps surprising response to this question was that **79% indicated they did not need the hotel option.** They indicated quite specifically “I don’t care if I stop anywhere.” This response is probably related to these particular respondents’ former experiences on adventure trips where comfort was not a high priority.

Of the 21% who did indicate that a stopping point would be important, Fig 8 provides the indication of their degree of willingness to pay for the option. We see that **73% would pay up to a 20% premium on the trip price**, while the remainder would pay up to a 50% incremental premium.



CORPORATE SPACE TOURISM AND LOTTERIES

Most work that has looked at potential demand for space tourism has operated on the assumption that the tourist would pay for the opportunity from their own funds. Two other ideas have been suggested, however, where a space tourist does not have to be personally wealthy to have the experience. The first of these approaches is referred to as corporate space tourism, where a company offers a space trip as a prize for performance of its executives. Another idea is simply to use a lottery with a space trip as the prize. This survey has done some preliminary work into exploring the acceptability of these ideas. A third idea, that of TV Game Shows, or “Reality TV” shows with a space trip as a prize, has also been suggested, but was not specifically addressed in this survey (mainly because of similarity with the other two approaches, and in order to keep the respondents’ tasks manageable within a 15 minute timeframe).

The corporate space tourism question was asked from two perspectives; that of the potential prize recipient and that of the corporation potentially awarding the prize. Not surprisingly there was a difference in these two responses. The precise formulation of the questions was:

“It is expected that companies will consider offering civilian space flights (suborbital or orbital) as sales incentives, rewards for performance or sweepstakes prizes. Would you want the chance to win a space flight or to earn one through sales performance, credit card points, frequent flyer miles, etc?”

Not surprisingly, **91% answered yes.**

Then the second question was posed:

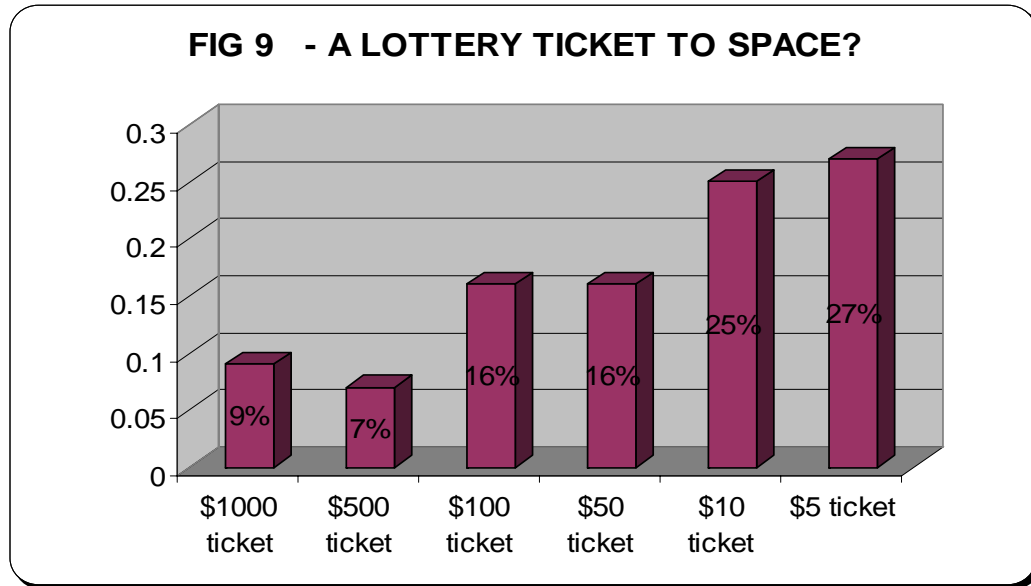
“OK, Let’s say you are the person in charge who gets to decide what sort of prizes or incentives your company offers. Would you consider offering a space flight?”

Now we find that, **instead of 9% declining the offer, the number increases to 16%.** Detailed thoughtful comments of the respondents explained this in terms of concerns about putting high performance employees at risk, insurance issues, and losing them for the duration of the training period.

The last category under this section heading was related to space lotteries. The question was quite lengthy in order to make sure the respondents were aware of the risk tradeoff implied by the offer. It was formulated around the concept of an orbital spaceflight opportunity:

“Since the cost of an orbital flight is expected to be \$10 million or more, some people have suggested creating a space flight lottery. If the grand prize was a two-week orbital adventure, with a retail value of about \$10 million, how much would you pay for a lottery ticket? (And yes, we know your odds of winning might play a role in your decision, so assume they’d be about the same as that of winning a local state lottery. But assume you won’t have to pay the taxes associated with winning a \$10 million prize....that’s too scary to think about.)”

Fig 9 shows the aggregate response to this question, from which we conclude that a surprisingly high percentage (**31%**) **say that they would pay as much as \$100 or more for a ticket.**



4. Market Data Update

It has been pointed out that this Adventurers' Survey *cannot* be used to provide a true market forecast update from the values derived in the Futron/Zogby survey in 2002 (Ref 1), due to the fact that a statistically valid random sampling technique was not used. Nevertheless, some valuable insights are obtained about the tendencies of this special group of Adventurers with regard to various space experience offerings, especially with regard to matters of pricing. The issue was addressed via a number of discrete steps, so that we could obtain an insight into the gross market opportunity before such factors as price would enter the equation.

GROSS MARKET OPPORTUNITY

It was decided to explore a full range of space experiences. The precise formulation of the first question was:

“Pretend money does not matter. Either you have lots and lots of it or someone else is buying. Which of the following adventures would you like to experience?”

To ensure that the respondents all had the same comprehension of the offerings, the following definitions were provided:

“High Altitude Jet Flight This adventure is carried out in the cockpit of a two-seater high performance jet fighter plane. The pilot takes the adventurer as high as it is possible to go without rocket motors, and although it does not quite reach space, the sky gets to be a very dark blue at the peak of the climb.”

“Zero-G Flight This is an adventure which uses a specially converted aircraft that flies like a roller coaster to provide a zero-g experience to its passengers. You float freely inside and are encouraged to try various zero-g games such as tumbling. The aircraft provides a series of zero-g experiences. This is one of the training techniques used by NASA for its astronauts, now everyone can join in the fun!”

“Space Training This is a specialized program designed to help prepare you for the physical and mental conditions of space. This could be a program involving the use of simulators, like those at the Yuri Gagarin Astronaut Training Center in Russia. Or, it could be centrifuge training or a flight in a zero-gravity plane. It could also be the type of fast jet training NASA gives to its mission specialists, or training for weightlessness in an underwater facility.”

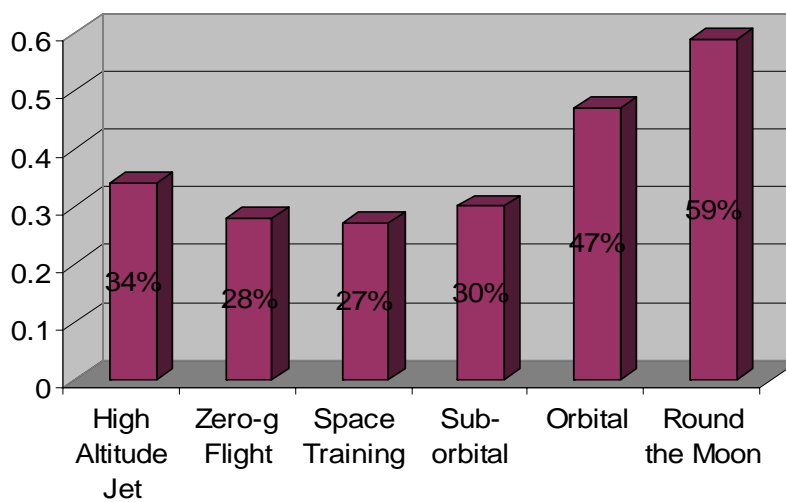
“Suborbital Flight This is an adventure where you go straight up into space (ie above 60 miles high), spend about 5 minutes in zero-g, then descend straight back again. The flight takes about an hour in total, but time in space is limited to about 5 minutes. You see the black sky, the curvature of the Earth’s horizon, and the view for hundreds of miles in every direction. This flight is like the first American spaceflight by Alan Shepard.”

“Orbital Flight This is an adventure where you go into orbit and keep circling the Earth every 90 minutes. You will see all the countries and oceans below you, and will experience a sunrise and sunset 16 times each day, and be in zero-g the whole time. This flight gives you the same views and experiences as today’s Shuttle astronauts. In some of the flights, there will be a docking with a space hotel. In others, you will remain in the spaceship that brought you!”

“Round the Moon This adventure takes you away from Earth on a 3-day journey to the Moon. After going round the Moon six times (ie 12 hours) you will fly the 3-day return journey back to Earth. This will be an experience just like the early Apollo missions, but will not include a landing on the Moon.”

The aggregate response to the “pretend money doesn’t matter” question is given in Fig 10. All of the offerings in this scenario are attractive to these Adventurers. But there is most interest in the most exotic trips, with **47% opting for orbital and 59% for going round the Moon**, given the chance. In explanation, one respondent indicated “If you are going to all the effort and time to get trained, you might as well go for Gold!”

FIG 10 GROSS MARKET OPPORTUNITY



The next step in the process introduced the pricing variable. In the full survey, this data is available for all 6 experiences, but for this Executive Summary, only the last three adventures are analyzed. The pricing issue was handled in two steps, with the precise formulation of the questions being:

“Now, pretend you have lots and lots of money and you *want* to do everything below. Please indicate the highest amount you’d pay for each of the following. (In other words, what do you think is a *fair price* for each program?)”

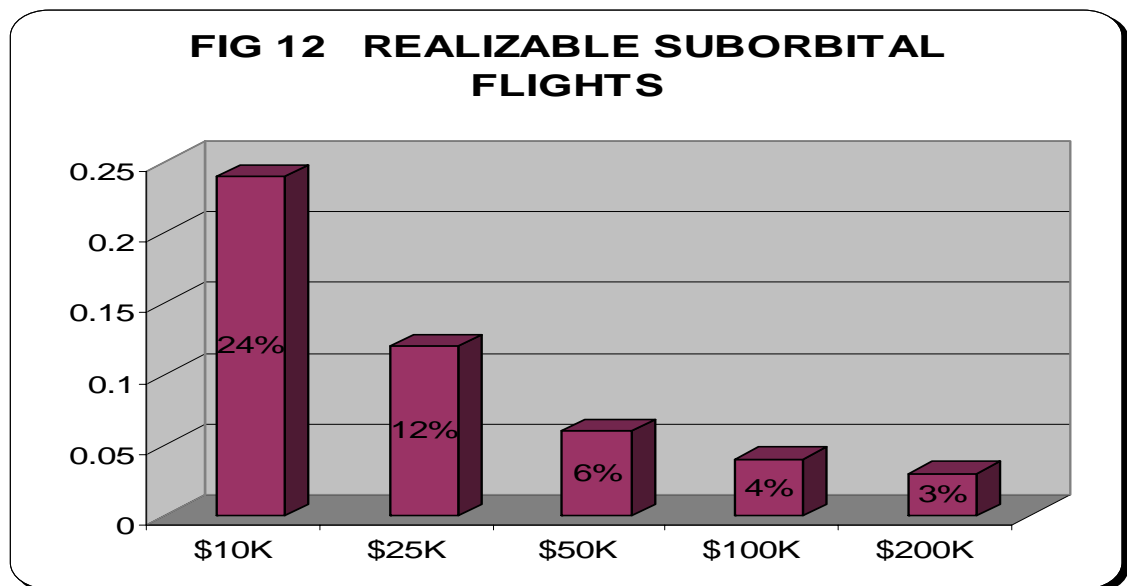
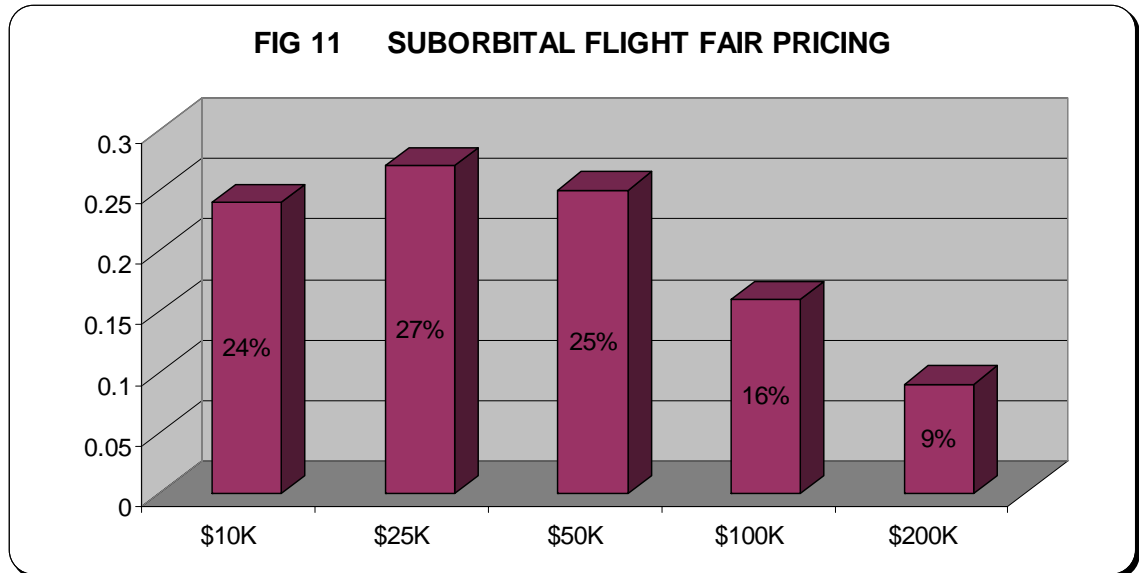
After obtaining these responses, the following question was asked:

“OK, now it’s time to get real. Which of the following adventures do you see yourself *actually doing* someday...even if you don’t win the lottery or get a big inheritance from some lost relative? Please check only those, if any, and then select the amount you both *could and would* pay. (This is our subtle way of discovering what you both want to do and can afford to do.)”

The responses are shown below in sequence for Suborbital, Orbital and Around the Moon trips. Recall that only 14% of the respondents are currently millionaires.

SUB-ORBITAL TOURISM

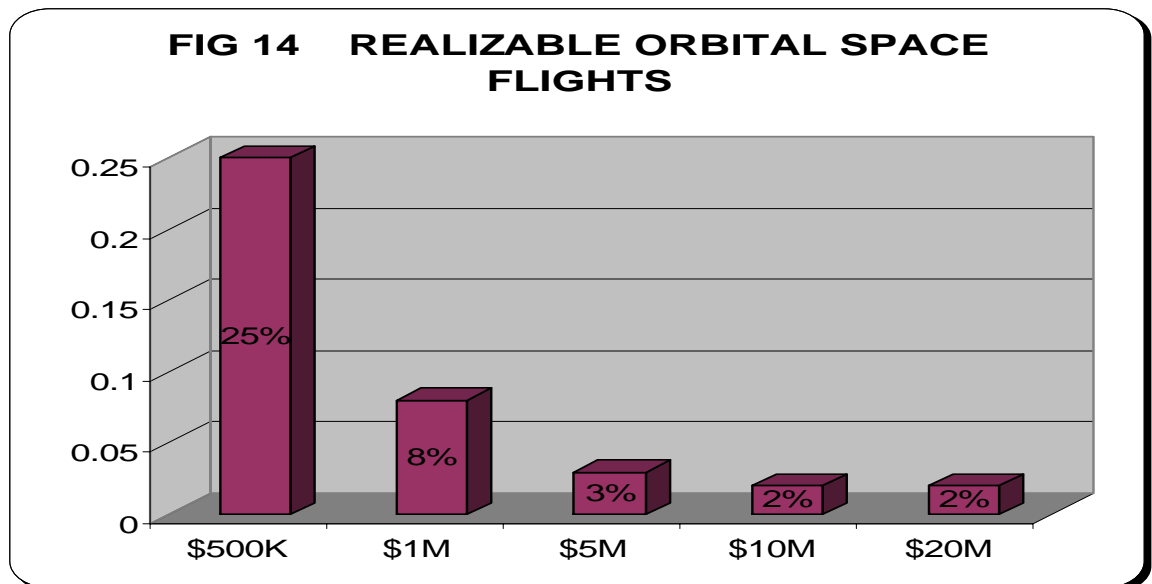
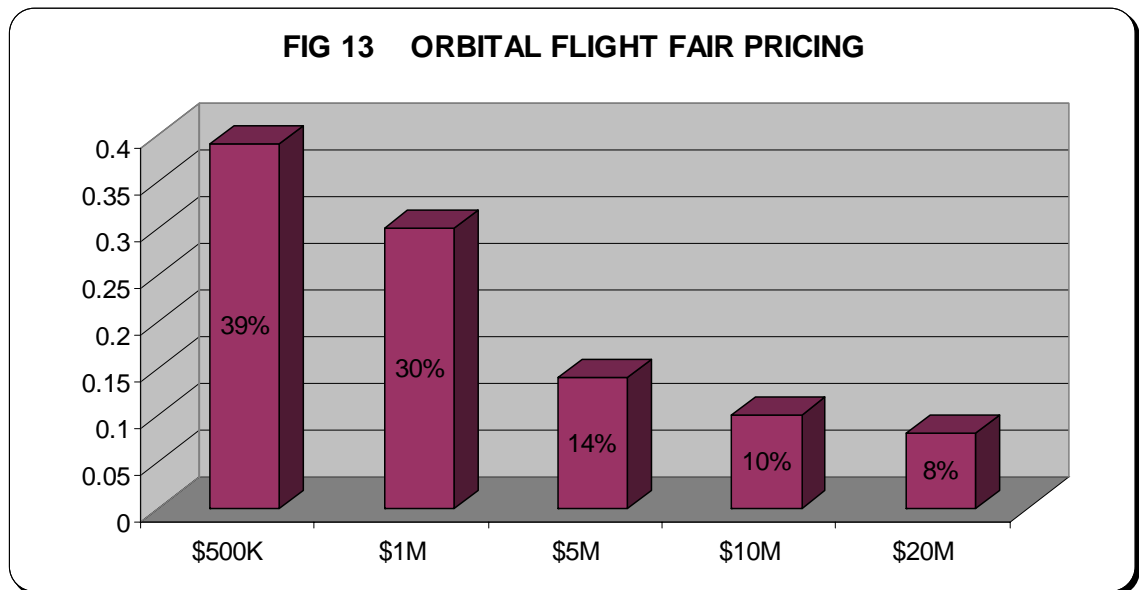
Fig 11 and Fig 12 show the aggregate responses for the suborbital space trip experience. We notice that this group in general indicates a view that **“the fair price” for suborbital flights should be \$50K or below**, with only 25% accepting the currently quoted price levels. Note that respondents were given no *a priori* indications of proposed pricing.



We then find that **only 7% of this group say they will undertake flights at the current prices of \$100K and above**, whereas below \$50K, 36% would be interested.

ORBITAL TOURISM

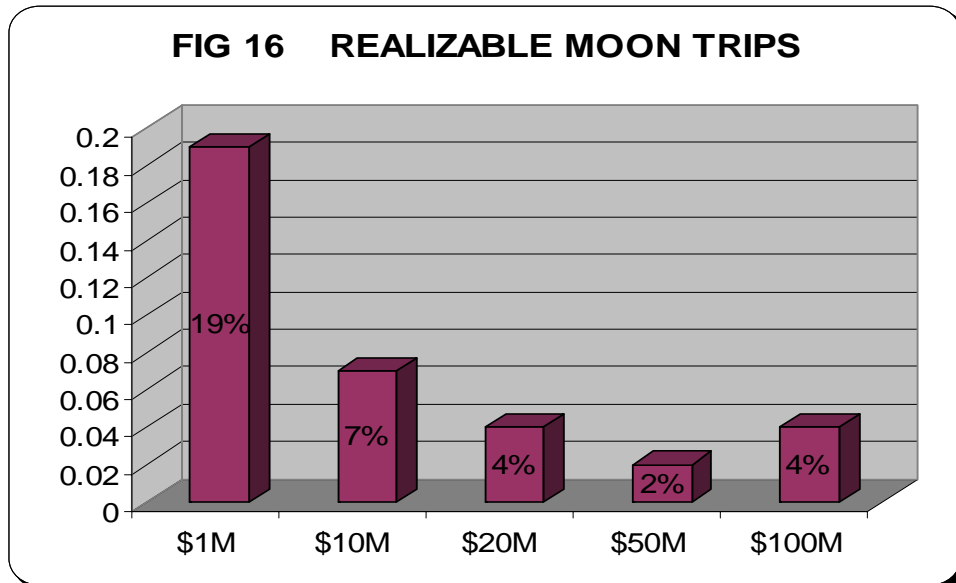
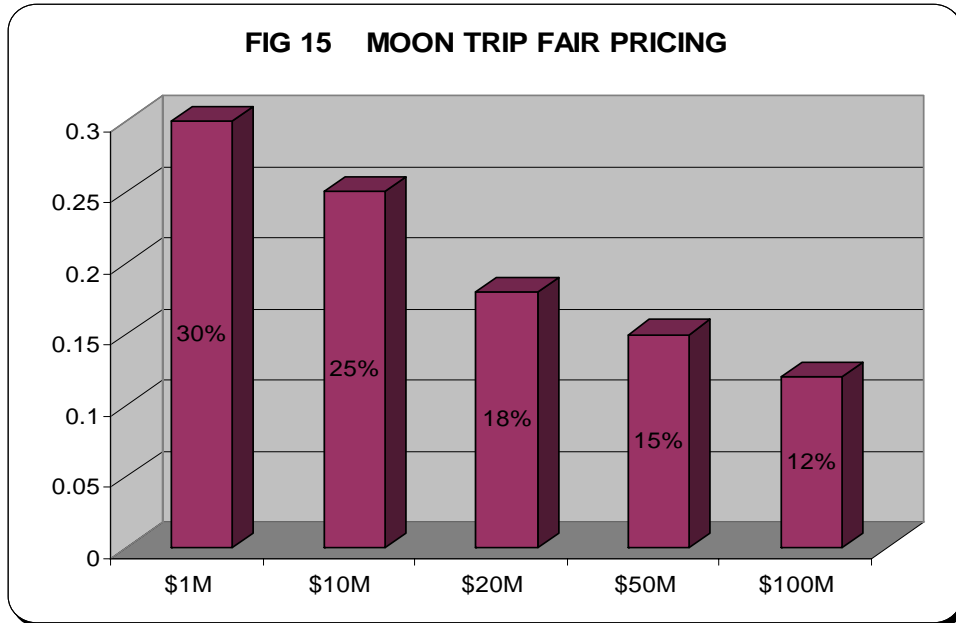
The aggregate results for these respondents with respect to Orbital spaceflight are given in Fig 13 and 14. They clearly take the majority view that **“the fair price” for an orbital flight would be \$5M or below**, with only 18% accepting the current price levels.



Only 4% of this group “could and would” try for an orbital flight at the current price levels. Clearly, though, there would be a big uptake at prices below \$1M, if such price levels were ever achievable.

MOON TRIPS

Fig 15 and Fig 16 show, on the same basis, the aggregate response for the round-the-Moon trip offering.



The responses to this first exploration of demand indications for lunar tourism do not provide any precise insight, because the concept is so new, and certainly perceived to be so expensive. The main finding is that there is not as yet a firm consensus on what would be a “fair price” for the Moon trip, with significant numbers believing however that \$50M to \$100M prices would be fair.

Even though 59% of the group wanted to do the Moon trip (see Fig 10), we note unsurprisingly that most of the people in this group do not expect to be able to afford such a trip, certainly at the currently quoted \$100M price. Nevertheless, **4% do say however that they would (hoped they could?) be ready eventually at \$100M.** If the price could drop to \$1M, then 19% say they “would and could” go eventually. There is no question from the individual statements of respondents, that this group believe that “space travel is the ultimate tourist adventure”, and that furthermore the Moon trip is the “Gold standard”. Some respondents said, for example: “Around the Moon?-Beyond my wildest dreams!”, “Apollo 8 was the greatest adventure”, “Would really like a surface stay on the Moon”.

SCHEDULING ASPECTS

A difficult aspect of forecasting demand is trying to assess the likely take-up rate for the business. In the approach used in Ref 1 and Ref 2, comparisons were made with other new industries, to ascertain the likely duration of the S-curve of demand growth. An attempt was made to get some data to help in calibrating this growth curve for space tourism. The precise formulation of the question was:

“Scheduling your Space Flight. – Let’s assume you’re planning to buy a space flight. When would you want to go?”

The alternative time periods were described as follows, and Fig 17 provides the aggregate responses.

“I want to be among the first civilians to fly to space and am willing to pay extra for the privilege.”

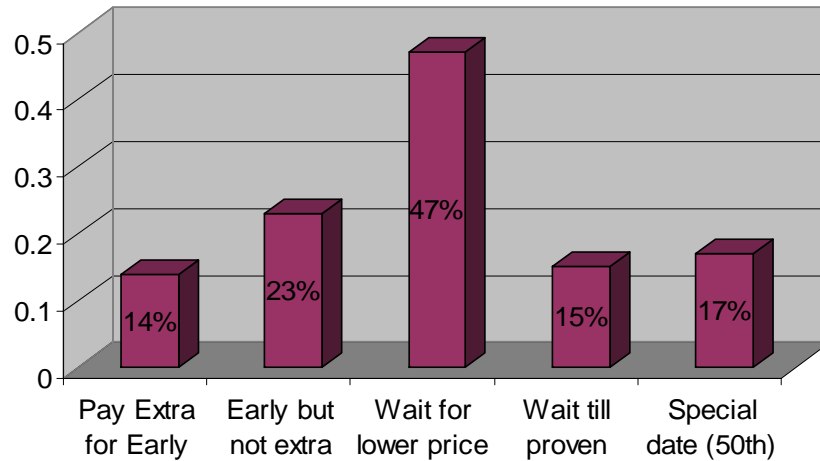
“I want to be among the first to fly but not enough to pay extra.”

“I will wait a few years and hope the price comes down.”

I will wait until a lot of flights have happened so I know it’s safe.”

I’d want to fly on a special date, like my 50th birthday.”

FIG 17 WHEN DO YOU WANT TO FLY?



We can see from this response that only 14% of the respondents really care about pioneering, and 47% will wait for the price levels to drop (to the levels indicated in the Fig 11, Fig 13, Fig 15 charts). A further 15% are currently worried about safety of the ventures. **This implies that the 14% represent the early adopters**, who pay the highest price, and who are followed by the remainder as experience is accumulated and as prices fall (due to technological developments that bring the unit cost down). This data in general supports the thinking in the Futron/Zogby forecasting methodology (Ref 1), and therefore there is no need, as a result of this work, to change the S-Curve characteristics used in that study. It still makes sense to assume an S-Curve profile through time, with duration of about 30 to 40 years to reach maximum.

5. Conclusions

This Adventurers' Survey has provided new and updated insights into public perceptions of the nascent space tourism industry. With a sample size of about a thousand respondents, it has provided a reliable assessment of the perceptions and requirements of the adventurous people who frequent the Incredible Adventures web site. We have been able to "fill in some gaps" in our thinking about how this new industry may emerge.

We have found, for instance, that time needed for training is not likely to be an issue, at least regarding sub-orbital flights, although some streamlining will be needed for the orbital experience, where 59% state that 3 months of training is the maximum acceptable duration.

We found that respondents will be happy with 2 weeks as the planning assumption for duration of orbital space flights (70% will be happy with this figure).

Regarding spacecraft architectures, there are some clear preferences, particularly with regard to landing, where a horizontal landing is preferred over a vertical parachute descent by a factor of six.

Spaceports do not currently figure much in the opinions of respondents, but there is strong interest (88%) in EVA, with most (85%) being willing to pay a 20% premium for the option. There does not yet seem to be much interest in the orbital hotel destination (79% said they do not believe they need the hotel option). Of those few who do say they need the option, 73% would pay an associated 20% premium.

Regarding corporate space tourism, there was some cautious feedback at this early stage of the business. Folks are worried about risk to key executives. Space lotteries, however, seem to represent an attractive proposition, with 31% saying they would pay \$100 or more for a ticket for an orbital space trip.

There continues to be strong interest in all space tourism possibilities, and this survey included Round the Moon Trips as one of the options. 59% said they would want to do this if they could afford it. This group of respondents is generally not rich enough to be able to afford to do the trips that they would wish to experience. Nevertheless, 7% said they intended to go for a sub-orbital flight at today's prices of \$100K - \$200K, and 4% said they would eventually go for the orbital experience at \$10M - \$20M. There was, moreover, perhaps more importantly, a clear indication of price levels that would trigger a major response from these respondents. For sub-orbital spaceflight the level would be \$50K; for orbital space tourism, the trigger price is \$500K; and for the circum-lunar flight, the trigger price would have to be \$1M for this group of Adventure Travelers.

Despite their strong interest in having a space tourism experience, most of the respondents in this group (62%) are willing to wait before taking their trip until prices drop considerably and the technologies are proven. Being a pioneer turns out to be not so important as was first thought.

6. References

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