INSURING HUMAN SPACE FLIGHT: AN UNDERWRITER’S DILEMMA

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I. INTRODUCTION

In this last decade, a number of events have significantly altered the way the world perceives risk. Acts of terrorism, natural disasters, and economic turmoil have fundamentally altered public awareness of the inherent risks that permeate human activity. Nowhere has this awareness had such an impact as it has had in the insurance industry. Many of the greatest losses the industry has ever experienced have occurred in the past ten years, including the catastrophic losses sustained in the United States from the September 11, 2001, terrorist attacks. Losses sustained by insurers from these attacks alone amounted to more than one and a half times the next largest catastrophic loss in insurance history.1 As a result, insurers and underwriters have become extremely sensitive to assessing risk and pricing insurance to adequately cover these risks.

Despite the heightened level of sensitivity among insurance underwriters, many industries still rely on insurance to manage risk, thus affording opportunity for growth.2 Insurance acts as a risk-shifting device.3 Essentially, risk is passed from a risk-adverse party to a risk-neutral party for a fee.4 The difficulty lies in fully understanding and assessing the risk. Although both parties present information concerning the risk, a level of un-

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1 R. Glenn Hubbard et al., The Economic Effects of Federal Participation in Terrorism Risk, 8(2) RISK MGMT. & INS. REV. 177 (2005).
4 Id.
certainty remains in every insurance contract. Surprisingly, one would think that a phrase like “Anything is possible,” should scare insurers, but in actuality, a limited amount of uncertainty provides an opportunity to increase profits. These limits derive from the fact that insurance companies are not risk-neutral. Like most businesses, insurers act in an environment full of risks, where cost and information constraints limit the amount of exposure an insurer can take. These constraints influence insurers in situations where imperfect or no information exists, or where it costs too much to ascertain and manage the risk. Logically, insurers will not insure a risk of loss that may be immeasurable. Put more simply, insurers will not insure a risk of loss that does not result in a profit. Importantly, commercial human space flight is one industry that must rely on insurance to grow. However, cost and informational constraints inhibit the industry from taking full advantage of insurance benefits. This paper will address insurability issues with respect to commercial human space flight, and provide recommendations to improve the likelihood of insurability from an underwriter’s point of view.

II. THE PROSPECTS OF MORAL HAZARD, ADVERSE SELECTION, AND THE CATASTROPHIC LOSS

The principle question that an underwriter wishes to answer with respect to commercial human space flight is, whether flights can be insurable where the insurer can still create a profit? Generally, insurers will try to avoid three adverse prospects when insuring commercial human space flight in order to create a profit. They are moral hazard, adverse selection, and catastrophic loss. First, insurers wish to avoid moral hazard. Moral hazard refers to an insured party’s propensity to act with

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5 Id. at 6.
6 Id. at 3.
7 Id. at 4.
8 See generally John R. Olds et al., Space Tourism: Making it Work for Fun and Profit, in 51ST INTERNATIONAL ASTRONAUTICAL CONGRESS (Rio de Janeiro, Brazil, Oct. 2-6, 2000), http://smartech.gatech.edu/dspace/bitstream/1853/8405/1/IAA-00-IAA.1.3.05. pdf.
less care to avoid an insured loss than would be exercised if the loss were not insured. Moral hazard also includes taking additional risks after acquiring insurance with the underlying belief that the insurance will cover the loss. Moral hazard could be a significant issue in the commercial human space flight industry because of misinformation. As operators apply for insurance, insurance underwriters will require the operator to disclose information that materially influences the risk of loss. Often developing industries, like commercial human space flight, may not fully understand the factors that materially influence the risk of loss because those factors may be unknown or unclear. Operators may provide their “best guesses” or partial explanations to an underwriter, but ultimately the underwriter is still misinformed. After the operator acquires insurance, the operator may learn through experience that the information previously conveyed to the underwriter understates the risk. If the operator continues to offer space flights without notifying the underwriter about this new information, then moral hazard has occurred. Meaning, the operator may act with less care knowing that the insurer will still cover a loss if it should occur. This propensity may be particularly strong in the commercial human space flight industry because insurance is a significant cost in conducting the activity. Moreover, an operator may believe that an admission of any adverse information could tip the scale to a higher premium, or worse, uninsurability.

Underwriters may combat moral hazard in a number of ways. Typically, with an unfamiliar industry, such as commercial human space flight, underwriters may look to an operator’s propensity and approach towards risk-taking in other activities. If an underwriter determines that an operator has had a

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9 Abraham, supra note 3, at 7.
previous problem with moral hazard that may indicate a similar incident in the future. Arguably, some people see human space flight as a tourist activity reserved for risk-taking adventurers.\(^\text{13}\) While this may raise a red flag to an underwriter, stereotypes have little influence if the operator has avoided moral hazard and managed risk well in the past.

Second, insurers try to limit adverse selection as a part of underwriting. Naturally, a party having a higher risk of loss is more likely to obtain insurance coverage than a party with a lower risk of loss. The party with the higher risk may have a greater incentive to misinform an insurer to obtain insurance, thus resulting in adverse selection.\(^\text{14}\) In commercial human space flight, adverse selection could occur when an operator either knows or suspects information that will influence an underwriter’s risk assessment of the operator’s activity. The operator could subsequently withhold, underestimate, or even lie about that information, to either obtain insurance, or to obtain insurance at a lower cost. Moreover, operators still have many questions that remain unanswered with regard to the operational risk involved in commercial human space flight. Operators hold a unique position as the principle provider of risk information for commercial human space flight. Even though information provided by a single source raises questions of quality and may be difficult to verify, underwriters receive the best available information to assess risk from operators. More importantly, operators are willing to work with insurers by taking steps to become more informed and to minimize risks.\(^\text{15}\)

However, underwriters must reasonably address adverse selection to make an accurate risk assessment. Invariably, the answers to the questions surrounding risk change with each


\(^{14}\) ABRAHAM, supra note 3, at 6.

\(^{15}\) Denis Bensoussan - Hiscox, Space Tourism Risks: An Insurance Perspective (paper presented at the IAA 1\(^{\text{st}}\) Symposium on Private Human Access to Space, Arcachon, France, May 30, 2008) (highlighting a risk management strategy that operators will have to explain to the underwriter what they are doing to justify their technical choices) (on file with author).
new development and test flight. Operators can help underwriters prevent adverse selection by sharing information on the associated risks and developing methods to address these risks.\textsuperscript{16} For example, the National Aeronautics and Space Administration (NASA), along with the Commercial Spaceflight Federation and the Universities Space Research Association have created the Commercial Suborbital Research Program.\textsuperscript{17} This program was designed to provide valuable research on ways to reduce risk in commercial human spaceflight.\textsuperscript{18} Thus, a concerted effort to understand information concerning safety, regulation, informed consent, vehicle design and delivery, consumer demand, as well as other factors, will help operators and underwriters address adverse selection appropriately.

Finally, the insurer will try to avoid a catastrophic loss. A catastrophic loss has the potential to force the insurer into a situation where the insurer is unable to pay all claims levied against it, thus forcing the insurer out of business.\textsuperscript{19} Scenarios that could make an insurer insolvent include, substantial loss of life and limb, extensive property damage, immeasurable third-party liability, and other domestic and international tort liability. Significantly, the risk for catastrophic loss is pervasive throughout commercial human space flight activities. For example, one could conceive a collision of a space flight with an orbiting space hotel, or a launch explosion taking the lives of the crew, space flight participants, and innocent third parties, as catastrophic events.\textsuperscript{20} Conceivably, insurers could lose billions

\begin{footnotes}
\item[18] Id.
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of dollars as the result of a single incident, especially where many lives are lost and property damage is extensive.\textsuperscript{21} Traditionally, underwriters have dealt with moral hazard, adverse selection, and catastrophic losses by ‘risk-pooling’ and relying on the law of numbers.\textsuperscript{22} ‘Risk pooling’ involves combing individuals with similar characteristics into a single pool, whose individual insurance costs are combined and then divided to calculate premiums.\textsuperscript{23} Essentially, pooling risks together allows the costs of risky to be subsidized by the less risky.\textsuperscript{24} Even though the individuals in a pool seem to carry the same risk because of supposedly similar characteristics, actual conduct reveals that some individuals may be more risky, or less risky, than others in the pool. Where risks are uncorrelated and independent insurers can pool and allocate these risks, thus making the sum of the individual risks less risky as a whole.\textsuperscript{25} Consider car insurance, some car operators provide perfect and truthful information to their insurers, others do not. The underwriter evaluates this information then organizes each insurance contract into pools by various degrees of risk. Although some contracts in a pool may not belong to that pool because they are actually more or less risky, the other contracts balance out the difference. Thus, the insurer has a greater ability to cover losses from the riskiest car operators and a greater ability to predict losses in larger pools. Unlike automobiles, only a handful of commercial human space flight vehicles and operators exist. Apart from the handful of operators scattered around the world, only 20 commercial space launch licenses are currently active and issued by the U.S. Office of Space Transportation (FAA/AST).\textsuperscript{26} Additionally, each commercial human space flight

\textsuperscript{21} Id.
\textsuperscript{22} ABRAHAM, supra note 3, at 3.
\textsuperscript{24} Id. at 2.
\textsuperscript{25} ABRAHAM, supra note 3, at 4.
\textsuperscript{26} Federal Aviation Administration, Commercial Space Data - Active Licenses, http://www.faa.gov/about/office_org/headquarters_offices/ast/launch_data/current_licenses/ (last visited Jan. 16, 2010).
vehicle possesses unique characteristics that make analogous comparison impossible, and pooling and the use of the law of numbers ineffective.

Consequently, insurers have used other techniques to mitigate the effects of moral hazard and adverse selection. For instance, limiting warranties and voiding policies due to misrepresentations are used as defenses in both property and life insurance claims. Typically, their effectiveness comes to light in insurance litigation. While, their effectiveness with respect to insuring commercial human space flight is yet unknown, at this point, only one fatal accident has occurred in the commercial human space flight industry with the potential to merit litigation. In 2007, three Scaled Composites employees were killed while testing a rocket engine. According to the FAA, this accident was not a launch related accident, but an industrial accident. As such, no issue with respect to insuring the space flight was raised. Only when space flight insurability becomes an issue in litigation will warranty and misrepresentation defenses enlighten underwriters as to their effectiveness in mitigating risks that involve imperfect information.

III. GOVERNMENTAL EFFORTS

Despite the difficulties of dealing with uncertainty and misinformation in the commercial human space flight industry, many governments have taken steps to improve the likeliness of obtaining lower cost insurance. The most notable being the principles established in the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (Outer Space Treaty). Now ratified by 98 countries, and signed by 27 others, the Outer Space Treaty outlines the responsibilities of State

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27 ABRAHAM, supra note 3, at 7.
28 Id.
Parties for their outer space activities. While the Outer Space Treaty does not directly address insurance issues, the treaty does establish a liability regime for governmental and non-governmental parties associated with a particular State. As such, the Outer Space Treaty requires that States regularly regulate and monitor all space activities under their jurisdiction to avoid international liability.

Thus, the Outer Space Treaty is the foundation for existing national laws that address the licensure and safety of commercial human space flight. For example, in the United Kingdom, the 1986 Outer Space Act establishes standards for licensing and safety. Sweden, Norway, and Belgium also have laws that govern certain space activities. In 2004, the United States enacted the Commercial Space Launch Amendments Act (hereinafter 2004 Launch Act). Unlike the space laws in other countries, the U.S. legislation provides operators the most advantageous environment to foster commercial human space flight. In general, the 2004 Launch Act aims to protect the commercial human space flight operator as well as the public. It grants authority to the Federal Aviation Administration (FAA) to issue licenses and experimental permits to commercial human space flight operators. Through its Office of Commercial Space Transportation (AST), the FAA fosters progress in commercial human space flight by facilitating the expansion of space trans-
portation infrastructure. The AST issues FAA licenses, tracks space launch data, and works with industry to develop safety programs.

Aside from the regulatory benefits provided by the FAA, the 2004 Space Act also contains a unique indemnification provision that substantially influences insurance underwriting. According to the legislation, operators that obtain a license and operate in the United States must demonstrate financial responsibility by obtaining a specified amount of liability insurance. Analogous to underwriting, the FAA performs a maximum probable loss (MPL) risk analysis. Based on that risk analysis, the operator must obtain insurance for the lower of the computed MPL or $500 million. The United States government will then indemnify the operator for liability losses in excess of the required amount up to $2 billion. Liability in excess of $2 billion must be borne by the operator. Unfortunately, this indemnification regime only applies to operator loss and third party claims, not to space flight participants. By participating in commercial human space flight, space flight participants will be assuming their own risk and will have to sign personal liability waivers after receiving written disclosure and giving informed consent. Essentially, space flight participants will have to obtain individual insurance if they wish to insure their flight. Unfortunately, individual insurance may be difficult to obtain and may be very expensive for the space flight participant. Considering that only a few hundred people have flown to space, eight-

38 Id. & Rosenberg, supra note 35, at 56.
39 Id.
40 The MPL Calculation varies by launch vehicle type authorized to a launch site under FAA license at the FAA/AST. Federal Aviation Administration, Office of Commercial Space Transportation, http://www.faa.gov/about/office_org/headquarters_offices/ast/ (last visited Jan. 16, 2010).
41 Id. & Rosenberg, supra note 35, at 57.
42 Id.
43 Id.
44 Id.
een of which have lost their lives, the data and mortality rates do not support the insurability of space flight participants.\textsuperscript{46}

Aside from the benefits of the indemnification regime, the MPL risk analysis could provide valuable information to an underwriter. Although an underwriter’s methodology may vary greatly from that of the MPL analysis, the MPL analysis should give an underwriter a basic understanding of the risks involved in commercial human space flight. Also, since the FAA requires coverage for the lesser of the MPL analysis amount or $500 million, the MPL analysis could serve as a risk comparability tool among operators in the industry. More importantly, the MPL analysis highlights the FAA’s focus on public safety by requiring riskier operators to obtain additional insurance coverage.\textsuperscript{47} Some operators, however, have questioned the FAA’s current safety focus claiming that the risk analysis focuses too much on the safety of the public versus the safety of the space flight participants.\textsuperscript{48} Understandably, the FAA’s focus on the safety of the public must support the current indemnification regime in the 2004 Launch Act. In contrast, other industry experts argue that the safety of space flight participants will influence the safety of the third party public.\textsuperscript{49} The likelihood of an accident involving the death of a space flight participant directly effects damage to third parties due to the likelihood of collateral damage.\textsuperscript{50} Unintentionally, operators may forget that the overall purpose of a government is to protect and promote the public health and safety of its citizens. The protection of a few at expense of the majority conflicts with this purpose.

\textbf{IV. SAFETY REMAINS THE FOCUS}

Notwithstanding these arguments, a focus on safety is paramount to an underwriter. An underwriter’s focus on safety

\textsuperscript{46} Id. at 115 (citing Jeffery F. Bell, \textit{Rocket Plane Roulette}, SPACE DAILY, Mar. 7, 2007, http://www.spacedaily.com/reports/Rocket_Plane_Roulette_999.html (discussing the flight history of experimental rocket plans)).

\textsuperscript{47} Hughes & Rosenberg, \textit{supra} note 35, at 57.


\textsuperscript{49} Id.

\textsuperscript{50} Id.
does not emphasize to whom the benefit will be given, but to what extent does the emphasis on safety cover the risk of loss. Even though the MPL analysis does address certain safety issues, it is unlikely that the analysis provides enough safety information for an underwriter to adequately ascertain the risk of loss. Logically, spacecraft operators will have to close the information gap. The challenge facing the industry concerns setting standards that each operator can achieve, but also satisfy an underwriter's need for adequate information. For instance, Scaled Composites LLC founder, Burt Rutan, suggested an alternative solution to this challenge that would create a hybrid arrangement between the commercial human space flight industry and the FAA. Collectively, the commercial human space flight industry and the FAA could define and implement safety standards through self-governing policy and FAA regulation.

Currently, the commercial human space flight industry has established the Commercial Spaceflight Federation (CSF) to promote and pursue higher standards of safety within the industry. However, previous self-policing industry standards have achieved mixed results. For example, the ISO 9000 management standards created by the International Organization for Standardization to address enhanced quality management. Presently, the aerospace industry successfully uses AS9100 standards, a supplement to ISO 9000, to enhance quality in aerospace design and manufacturing. Conversely, the American accounting profession has had difficulty maintaining independence standards between auditors and their clients. In 2001, the Enron scandal exposed the failings of the American Insti-

tute of Certified Public Accountants (AICPA) as a regulating industry authority. As a result of the AICPA’s inadequate efforts to address client-auditor relations, the Securities and Exchange Commission (SEC) stripped the AICPA of its self-standardized policing and auditing power. Despite the mixed successes, the commercial human space flight industry can use the CSF to either police safety standards that exceed the FAA mandated level, or better yet, work with the FAA to improve safety standards.

Moreover, the continued development of safety standards between governments and operators sends a positive signal to underwriters that operators are combating moral hazard. Because of the developing character of the industry, operators realize that safety functions as a vital part of each space flight. Accidents would be destructive to the industry by reducing consumer confidence and opening the door to potential liability. Unfortunately, an over emphasis on safety may also be cost-prohibitive to many operators. Like all businesses starting out, a time arrives when an operator needs to generate profits. However, the emphasis on the bottom line may give rise to actions that push safety aside, increasing the likelihood of moral hazard for the insurer. Notwithstanding, opportunities exist where operators can more effectively utilize working capital without sacrificing safety.

Principally, operators can focus on safety development in areas of high risk through the use of simple control procedures. Operators that focus on immediate considerations such as reliability of reusable launch vehicles, the training and skill of flight and ground crews, and the adequacy of launch and landing sites, should address the majority of risk in the space flight activity.

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56 Id. at 369.
57 Walker, supra note 48, at 401.
58 Id.
59 Id. at 402.
An example of a cost effective approach using simple control procedures in particular areas is financial auditing. Part of an auditor’s responsibilities include understanding and providing an opinion on the risk of material misstatement in a company’s internal control.61 According to the Public Company Accounting Oversight Board (PCAOB), internal controls “must be in place to see that records accurately and fairly reflect transactions” of the company.62 When a weakness in internal control exists the risk for material misstatement increases.63 However, material misstatement can be hidden in one of the millions of transactions a company processes each year. Consequently, in order to manage auditing costs, the PCAOB recommends that auditors focus risk assessment on internal controls that have the greatest impact on material misstatement, as well as accounts where material misstatements are more likely to occur.64 Using a risk based approach, an auditor can address the majority of risk by testing only a few areas of internal control.

Applying this example to commercial human space flight, an area of very high risk is likely the launch and landing of the vehicle. Here, the commercial human space flight industry can take a lesson from the airline industry. For instance, after the 9/11 attacks, underwriters became more aware of the risks in aviation.65 As premiums increased, the airline industry appreciated the importance of identifying and remedying risky areas to control aviation insurance costs.66 Furthermore, empirical evidence shows that of the total number of commercial jet accidents, 57% occurred during take-off and landing. Specifically,

62 Id. at 2.
64 Id.
66 Id.
12% of commercial accidents occurred at takeoff, and 45% occurred at landing. As a result, the trend has shifted in assessing aviation insurance from the total volume of passenger miles flown as an insurance basis, to the number of passengers flown and the number of departures. Thus, recent developments in aviation insurance have encouraged airlines to address the majority of risk by focusing on take-offs and landings in an effort to improve safety. Appropriately, in 2008 the airline industry had one of the safest years on record.

Likewise, the commercial human space flight industry may also reduce risk of loss by focusing on the launch and the landing of the space vehicle. Not only do the launch and landing present a significant risk to the public, but also could present substantial stress to the vehicle itself. This is such a significant concern that the FAA issued a guide to operators that focuses on the reliability of reusable launch and reentry vehicles. In addition, the FAA report to the U.S. Congress on the analysis of human space flight safety, suggests that lessons can be learned from the Challenger launch and Columbia reentry to avoid future public safety hazards in commercial human space flight.

V. REDUCING THE COST OF INSURANCE: AN OPERATOR’S EFFORT

As part of focusing on areas of risk, operators should realize that an underwriter’s assessment of risk would likely involve an expected value analysis to compute a premium. Generally, an

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67 Id. at 1292.
68 Id.
underwriter will convert the likelihood of an accident occurring, at some point in the space flight, into a percentage. The underwriter will also assess the amount of property damage from that event. The likelihood that something may occur, and the amount of loss, are computed to arrive at an expected value.\textsuperscript{73} For example, let’s assume that an underwriter assesses that there is a 10% likelihood that a $100,000 loss could happen at a particular point in the space flight. Also, assume that at another point in the space flight a 1% chance of a $1,000,000 loss could occur. An operator may think to focus safety procedures on the greater loss, but to an underwriter the expected value (.01 X $1,000,000 = $10,000 = .1 X $100,000) of each event is the same. Therefore, an insurer would likely assess a similar premium for both events. Thus, a simple expected value analysis of different phases of the launch can help operators understand where to focus their safety efforts. As operators address risks at areas of higher expected value, costs of insurance will decrease.

An operator may also strategically locate a spaceport to reduce insurance costs. For example, while constructing a spaceport closer to sea level may provide access to a greater number of people, a spaceport located at higher altitude may be less risky and save on fuel costs to enter and return from a suborbital trajectory.\textsuperscript{74} On the other hand, a launch from high altitude may be riskier because of cooler temperatures and the presence of other physical elements, such as snow or ice. Another influential factor for underwriters would be a decision to locate a spaceport near a highly populated area versus a more rural location.\textsuperscript{75} Logically, the risk of loss to third parties should be less in a rural setting compared to that of an urban setting.

In addition, another important consideration relating to third party loss would be the use of a range safety officer in commercial human space flight. Traditionally, range safety procedures concentrate on protecting the public throughout the

\textsuperscript{73} ABRAHAM, supra note 3, at 3.
\textsuperscript{74} Scott, supra note 60, at 8.
\textsuperscript{75} Id.
launch and flight. Part of these procedures involves the range safety officer’s ability to terminate a vehicle during launch or flight if it poses a serious risk to the public. Currently, range safety procedures do not differentiate between manned and unmanned flights. For example, a range safety officer monitors each flight of NASA’s Space Shuttles. In fact, after the explosion of Challenger in 1986, a range safety officer detonated the solid rocket motors as they veered towards land. The officer determined that the motors posed a serious threat to the general public. Obviously, underwriters will pay close attention to an operator’s emphasis on range safety. The part a range safety officer plays in the overall range safety strategy remains to be seen. The ability to detonate the insured’s property adds a new dimension to underwriting commercial human space flight.

Furthermore, the design of the space vehicle, and method of delivery, are also significant factors in risk analysis for insurability. Typically, rockets contain explosive propellants that can cause extensive and deadly damage. Alternatively, some vehicles are launched from airplanes as opposed to being launched from the ground. Notably, the risk of loss varies with an air launch versus a ground launch. Although making comparisons among vehicle design, vehicle delivery, and range safety can be difficult, an expected value analysis can translate risks into comparable monetary amounts. This tool allows the operator to weigh the benefits and detriments of a particular

80 Id. at 185.
81 Id.
83 Id.
operational strategy and make changes where necessary to improve safety and perhaps profitability.

VI. UNDERWRITER CONCERNS

Despite the many methods an operator can apply to improve the insurability of space flight, there is an overriding concern that troubles the underwriter: imperfect information continues to inhibit the industry from literally getting off the ground. Consider the question of whether consumer demand will be sufficiently consistent to support commercial human space flight? Business risk and going concern questions still plague the commercial human space flight industry.84 These questions relate to operators actively engaging in business with the expectation of indefinite continuance.85 Operators, however, maintain that consumer demand will be strong enough to support the continued activity of commercial human space flight.86 Others have offered evidence to the contrary. One study, conducted by the Futron Corporation, targeted 450 households with a net worth of $1 million or a household income of $250,000.87 The Futron Study considered these respondents to be the potential customers of the commercial human space flight industry. The respondents were informed of the benefits and detrims of human space flight, and then were questioned regarding their level of interest in the activity.88 Only 20% of the respondents showed interest in commercial human space flight after being informed about the dangers, and only 16% indicated they would be willing to pay $250,000 for a space flight.89 This information not only suggests that income and informed consent may be barriers for some consumers, but it may also suggest a weakness in demand.

85 BLACK’S LAW DICTIONARY (8th ed. 2004).
86 DePasquale et al., supra note 13, at 3.
88 Id. at 48.
89 Id.
Aside from consumer demand, the absence of historical and comparable information remains a weighty concern for underwriters. In an attempt to improve the quantity and quality of information, industry leaders have promised to work to inform insurers. This could include relaying information obtained from trials and testing. However, the inability to ascertain every loss scenario in the real world through testing makes trial data preliminary at best. Only through actual operating experience will the underwriter become informed enough to make an accurate assessment.

A more recent concern for both the underwriter and the insurer has developed in the past year. Accessibility to capital financing has influenced the risk portfolios of insurers, banks, and businesses. Exacerbated by the worthlessness of mortgage-backed securities, the world capital markets are functioning in extreme volatility and uncertainty. As a result, banks and insurers continue to tighten cash flow until a solution is presented that removes these abnormally risky securities, or until the markets stabilize. Essentially, banks and insurers feel that extending or insuring credit is currently too risky. This severely affects the commercial human space flight industry, because commercial human space flight is inherently risky. Additionally, insurers have shown a disinterest in adding risk to their risk laden portfolios. Therefore, operators will either have to pay more for insurance or be uninsurable.

Notwithstanding the current world economic environment, the commercial space flight industry has received help to weather this tough financial environment. Recently, NASA announced plans to invest $50 million in orbital commercial hu-

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91 Serena Ng & Liam Pleven, An AIG Unit's Quest to Juice Profit – Securities – Lending Business Made Risky Bets; They Backfired on Insurer, WALL ST. J., Feb. 5, 2009, at C1.

man space flight.\textsuperscript{93} NASA believes that investing in commercial human space flight will “foster entrepreneurial activity leading to job growth” and “reduce the gap in U.S. human space flight capability.”\textsuperscript{94} This investment not only shows NASA support for commercial human space flight, but the possibility that the commercial human space flight industry will provide cargo and crew for the international space station.\textsuperscript{95} Additionally, SpaceX recently acquired a maximum investment of $60 million from Draper Fisher Jovelison Venture Capitalists.\textsuperscript{96} Such investments demonstrate that the industry may be financially less risky than the current economic environment indicates. In the meantime, operators should continue to conduct test flights and develop safety procedures to reduce the risk of an accident.

Information obtained from these developments help underwriters to classify the type of insurance that is appropriate for the operator. The arguments vary among underwriters as to the type of insurance best suited for commercial human space flight. Some insurers refer to the structure of the space vehicle and argue that aviation insurers should insure the industry, while others argue that space insurers are better suited to insure the activity.\textsuperscript{97} However, simply deciding whether the vehicle is like an airplane, or more like a rocket, does not automatically categorize which insurers should insure the activity. Methods of delivery, the payload, and other technical criteria will determine who will insure the commercial human space flight. Undoubtedly, both aviation and space insurers will demand a focus on safety to deter liability.\textsuperscript{98} The underwriter will likely look to an operator’s process management to see how the operator has built safety and emergency contingencies into the system. In

\textsuperscript{94} Id.
\textsuperscript{96} Id.
\textsuperscript{97} Bensoussan – Hiscox, supra note 15, at 4.
\textsuperscript{98} Lloyd’s, supra note 82 (highlighting that principle concern for underwriters will likely be avoidance of personal accident liability as an example).
addition, underwriters look to the experience and training of ground and flight personnel, including the operator’s plan for continued training.\textsuperscript{99}

Moreover, an emphasis on redundancy and backup systems in high-risk areas is very important. The operator’s plans for the aging and frequency of use of the spacecraft will factor into the risk assessment.\textsuperscript{100} Flight environmental control procedures, including the role of the space flight participant, inform the underwriter what will happen during flight. Emergency systems explain the capability of the operator to handle potential accidents that could occur during flight. These emergency systems could be as basic as handing out parachutes, or as complex as utilizing an ejection capsule.\textsuperscript{101}

In addition, sound process management decreases the likelihood of an accident and potential liability. Although process management helps an underwriter gain an understanding of certain risks, other risks are still unknown. For example, what happens if an accident occurs resulting in a space flight participant fatality? Will the waiver of liability based on the law of informed consent be an adequate defense?\textsuperscript{102} Successful informed consent defenses rely on a standard of care that includes a premise that the individual is adequately informed of the material risks.\textsuperscript{103} Insurers and operators can only hope that they have informed the space flight participants adequately to allow them to understand the inherent risks and make a reasonable prudent decision.\textsuperscript{104} Even though some inherent risks may be unknown, or difficult to define, the standard of care depends on whether the space flight participant can make an informed decision from the information provided.\textsuperscript{105} The strength of informed consent policies and disclosures is an important consideration in any risk assessment. Process management and informed consent are only a couple of the risks that the underwriter will con-

\textsuperscript{99} Analysis of Human Space Flight Safety – Report to Congress, supra note 72, at 5.
\textsuperscript{100} Id. at 62.
\textsuperscript{101} Bensoussan – Hiscox, supra note 15, at 7.
\textsuperscript{102} Knutson, supra note 45, at 106.
\textsuperscript{103} Id. at 111.
\textsuperscript{104} Id. at 118.
\textsuperscript{105} Id. at 119.
sider. Other material risks worth consideration include risks of terrorism; business and market stability; and the soundness of political climates. Carefully identifying and addressing many of these risks allows the underwriter to form a better risk assessment of commercial human space flight.

VII. CONCLUSION

In conclusion, the dilemma an underwriter faces with respect to insuring commercial human space flight lies in the quantity of imperfect information and uncertainty. The industry is so new that insurers and underwriters know little about the potential risks and liabilities associated with the activity. Underwriters can rely on experience and make comparisons to other industries, but ultimately they have to rely on information provided by the operator. A one-sided source of information places the insurer at an extreme disadvantage when contracting for coverage. As such, the prospects for moral hazard and adverse selection abound in insuring the commercial human space flight industry. Due to the overwhelming informational constraints, the current state of the financial industry and inherent riskiness of space travel, the initial commercial human space flights will likely carry high insurance costs until insurers can obtain sufficient information to accurately assess an acceptable risk. In the meantime, operators, governments, and insurers should continue to develop safety standards, processes, and relationships to assure the success of the industry.