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THE SATELLITE INSURANCE MARKET AS A PART OF THE INSURANCE MARKET

The author proved existence of the satellite insurance market, gave its definition and characteristic features. Its current status has been described. Also satellite insurance as a special kind of insurance was marked out, including the basics of risk assessment.

Keywords: insurance market, market participants, satellite insurance, satellite insurance market

INTRODUCTION

We have been hearing about satellites and launch vehicles for many years, and each launch is interesting for the mass media, particularly manned flights such as the building of the International Space Station. So far, there have been a couple of hundred commercial geosynchronous communication satellites launched. Between one and two thousands commercial satellites are forecast to be launched in the first decade of the twenty-first century, giving launch rates of the order of a hundred per year. The building and launching costs of a satellite are typically between USD 175-250 million and may occasionally reach USD 400 million. Hence, the potential loss could be enormous.

Although the first satellite was launched in 1957 and the first ever satellite insurance policy was written in 1965, the first major loss did not occur until 1977, when the European Space Agency lost the OTS-1. This costs the insurance industry USD 29 million. But satellite insurance remains a little-known market.

At the beginning, satellite risk was mainly placed in the international aviation market, simply because this market was more familiar with the problems of space flight than other insurance markets. Owing to the complexity of the risks, however, and the danger of uncontrolled accumulation at insurance and reinsurance levels, a highly specialized independent insurance market was eventually developed (*Space flight ... 1993, p. 65*).

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Issues of satellite insurance and the satellite insurance market, in principle, are absent in Polish insurance writings. Similarly, international publications do not have a usual scientific nature. So, I undertook research in the area that up to now had not been studied. It was the first such a broad exploration of satellite insurance and the satellite insurance market, not only in Poland, but also worldwide. Before, in the mid 1980s, the Geneva Association did a study on the risks associated with space projects and its coverage (Blassel 1985). The main result of my study was the doctoral dissertation (Manikowski 2002). This paper contains only some part of that research.

In this article I will try to prove that the satellite insurance market exists. The main aim of this article is to establish the definition and characteristic features of the satellite insurance market as well as its place on the world insurance market.

To achieve that purpose it is necessary to carry out the following steps:

- defining the term “satellite insurance” and features of this type of insurance;
- introducing to risk assessment;
- defining the term “satellite insurance market”, its characteristics and status.

1. SATELLITE INSURANCE

In this paper I use only the term „satellite insurance” (instead of „space insurance”). So, what is the difference between “satellite insurance” (sometimes called spacecraft insurance; in German: Satellitenversicherung; in Polish: ubezpieczenia satelitarne) and “space insurance” (in German: Raumfahrtversicherung; in Polish: ubezpieczenia kosmiczne)? Is the scope of these terms similar? Often they are considered as synonyms. It is obvious that a satellite is not the same notion as outer space. If the classification of insurance is taken into consideration, we should note, that for “satellite insurance” the criterion of the kind of covered objects is used. However “space insurance” is distinguished by the criterion of area (space), in which a given object operates. That meaning of “space insurance” causes the following consequences: on the one hand, all objects and people in outer space could be insured, and on the other hand, insurance cover only applies to the period of the space project, after leaving the atmosphere (positioning, early operating and operating phases). The first remark does not make a

difference in the scope of “satellite insurance” and “space insurance”, because nowadays the only insured objects in outer space are satellites. But nothing stands in the way to insure other objects in outer space in the future. However, the second statement makes the scope of these terms different, since so understood “space insurance” encompasses too a short period of the space project. But including all phases of space project in special “satellite insurance” is also groundless. Insurance of production and transport risks is well-known and commonly used, so it should not be distinguished as a separate category of insurance, even if it protects such an expensive and technically complex device as a satellite. “Satellite insurance” should cover all actions connected with the preparations of a satellite to launch, its delivering into orbit and exploitation in outer space (Manikowski 2002, pp. 6-7).

Summing up these arguments, the term “satellite insurance” is on the one hand broader than “space insurance” – due to covering more phases of a satellite project. However, according to the criterion of the kind of covered objects the term “space insurance” is broader, because it admits to insurance cover objects other than satellites. So, I prefer and use the term “satellite insurance” as well as similarly “satellite risk” and “satellite insurance market”.

Satellite insurance is a special line and only a relatively small community within the insurance industry is actively involved in providing insurance for space launches. Insuring of satellite risk is difficult and requires from insurers a highly specialized know-how in pricing and claims handling. Satellite insurance has got an unsatisfactory risk profile and it is subject of such huge expenses, that even an all-year premium could not be enough to cover individual damage (only one failed launch can consume the whole premium – which is also typical of aviation, marine and oil-rig risks). It is a quite complex line of insurance that has features of many other classes (such as technical, property, aviation and fire insurance). Satellite insurance is also at least partly a kind of guarantee.

It is very difficult to draw a clear distinction between satellite insurance and other classes of insurance, because there are many lines of insurance and each one is different. Moreover, there is a problem with the definition of insurance. There are many different explanations of this word and none is perfect (Sangowski ed. 2001, p. 57). That is why we distinguished several features of satellite insurance (Manikowski 2002, p. 76):

- large possible losses in every single event;
- mainly total losses occur;

- difficulty in solving problems in outer space;
- difficulty in determining causes of accidents;
- small number of insured objects;
- lack of homogeneity of risk;
- possibility of large cumulative risk;
- covered object (satellite) in an unfriendly space environment;
- insuring against not only damages caused by outside forces, but also against damages which the satellite causes to itself (satellite/rocket breakdown);

Because a relatively small number of companies provide satellite insurance, some believe that a loss in one area of satellite insurance directly influences the ability to cover other risks. Before the Challenger accident there was disagreement as to the relationship between the different types of satellite insurance. All types of satellite insurance rates have risen regardless of loss ratios. The reason is straightforward. The same players underwrite portions of all different types of policies so that losses all come out of the same small pool. Some insurers have concluded that the satellite insurance industry requires a much higher number of events (launches) — possibly 600 with each different launch vehicle — to accurately measure risk (Hollings 1988, p. 7). While other areas of insurance benefit from the law of large numbers, meaning that an event occurs many times (for example, in motor insurance), increasing one's confidence in being able to estimate the outcome, the satellite insurance industry is working with much smaller numbers. Large numbers are needed to increase the statistical validity of predictions, but in space launches, there may never be enough events.

Insurance, in its simplest terms, is the losses of the few being shared by the many, and operates according to the law of large numbers. Satellite insurance does not fit this definition as the losses of the few have also been shared by the few. Satellite insurance does not enjoy the spread of risk of other lines of insurance. In fact its spread is dangerously thin. Any one event skews the experience, provoking significant swings in the rates. It is an obvious maxim in this business that the impact of failures on rates far outweighs the effect of successes. There are not enough statistical events, as yet to work with reliability (Hollings 1988, p. 8).

Insurance for space activities has developed after many years of work by aerospace clients, brokers and the worldwide underwriting community. The goal of that work was to provide flexible forms of insurance for a volatile class of exposure, not yet quantified by loss data and experience in that field

(d'Angelo 1994, p. 65). In time and with increasing experience of insurers and those insured, the insurance market has offered better and better scope of insurance cover. Currently we can distinguish three basic groups of satellite insurance (Wegener et al. 1997):

- (1) property insurance (pre-launch, launch, in-orbit insurance);
- (2) third party liability insurance;
- (3) warranty insurance (launch risk (re-flight) guarantee, loss of revenue, incentive payments insurance).

2. BASICS OF RISK ASSESSMENT

Risk assessment in satellite insurance is very difficult – there are too little insured satellites to use the law of large numbers – moreover, the risk is heterogeneous. Therefore, it is important to identify the potential sources of risks involved. This is called “satellite risk”. This is risk connected with preparation of a satellite to launch, its delivering into orbit and exploitation. It includes typical “ground” hazards (for example fire and technical hazards) – well-known and standard insured, as well as “space” hazards connected with a satellite (or any other object) being in the unfriendly environment of outer space. The second kind is characteristic only for space projects. There are four main categories of satellite risk: asset loss, consequential loss, third party and product liability.

The satellites currently being launched fulfil a variety of needs including international telecoms capacity, domestic telecoms capacity in countries without legacy wire-line systems, international TV, GPS, meteorological coverage, mapping, military and scientific. This variety of needs results in a variety of different types of satellite being launched into the earth's orbit.

Each of these types of satellite will be likely to fail in different ways with different commercial consequences. For example, the loss of Intelsat-VI (F-3) in early 1992 would have meant the loss of revenues from relaying live television pictures of the Barcelona Olympics to North America (*Space flight ...* 1993, p. 61). By contrast, most scientific satellites have no direct revenues associated with them and the obvious value at risk is much lower.

Furthermore, these satellites are launched on a variety of different launch vehicles in several different countries. Not only will each type of launch vehicle have a different risk profile, but differing ground facilities will also affect the likelihood of a successful launch. Hence, while statistically significant, there is not yet enough data on each type of

launch vehicle to make satellite launch insurance easily priced and a true commodity like automobile insurance. One might hope, however, that given increased commercial demand for satellite platforms, sufficient data might rapidly become available.

To give a rough idea of the distribution of risk between these various phases, over 70% of failures occurred during launch. Similarly, 60% of losses are caused by the launch vehicle (Pagnanelli 1997, p. 30). These numbers clearly reflect the industry perception that “the majority of the losses are on the launch-pad.” While it is true that any loss during launch is likely to be a total loss and hence a very large sum of money can be lost in a single event, satellites are in orbit for much longer than the time they take to reach orbit. During this time there can be a number of failures, which may not necessarily entail a total loss.

The basic objectives of risk assessment is to identify and quantify the risk exposure arising from a business plan, and to structure optimum risk treatment solution from risk retention, risk transfer and insurance options available. When a client thinks about insurance, usually a broker helps in risk assessment. During this process many different elements are examined. These can be grouped into four main areas of analysis: financial, contractual, technical, and insurance requirements (Montpert et al. 1998, pp. 376-80; Parsoire 1997, p. 8).

A technical review includes analysis of the following elements: satellite performance specifications and design description, program, technical and management teams, quality control and product assurance, hardware heritage, launch vehicle reliability and operations. It allows to understand the technical nature of the programme, e.g. whether it is a production line satellite that needs minimal presentation to underwriters, or a “one-off” satellite, where all technical details will need full explanation. A broker usually helps to identify the technical aspects that will have the greatest impact on the insurance.

Assessment of the Launch Services Agreement, Satellite Procurement Contract, Finance Agreement and other related contracts exemplifies a contract analysis. It allows to identify the impact of the terms and conditions on the insurance and suggest adaptations to the insurance to accommodate the contract terms. Alternatively, a broker can advise on how the contract terms can be optimized to benefit the insurance and potentially reduce insurance costs.

A financial review involves an analysis of the Business Plan, Income Statement, Financing Requirements and other documents. On that basis a

broker is able to advise if the value being insured is appropriate or whether the requirements of financing are justified and how they can best be addressed.

A broker discusses insurance requirements with the client in order to assess the level of coverage required. The objective of this process is to produce an insurance coverage design. This will entail discussion on particular areas of coverage: scope of cover, policy period, sums insured, premium payment terms, loss definitions, constructive total loss point, salvage proposals, etc. (*Space Insurance Briefing* 2001, p. 36-38).

Each risk is supported by a substantial briefing package to the insurance community which is presented formally in London, New York and other centers of insurance competence. It aims to include typically: the business profile of the organization requiring insurance, in-orbit fleet details, ground segment description, spacecraft platform description, spacecraft payload description, heritage of equipment, list of single-point failures, integration, and test and product assurance plans (Hall 2001, p. 3).

These generate opinions and questions from underwriters' engineering consultants, which are routed via a broker to the spacecraft manufacturer or launch services provider or business entity requiring insurance as appropriate. The satellite manufacturer usually answers insurer questions on behalf of those insured. The "Questions and Answers" are legal documents which can be used in evidence if a claim dispute arises.

All systems and parameters of satellites are examined. Satellites are so complex that a breakdown of an otherwise benign component can prove critical and result in an insurance claim. In particular, an insurer will examine the heritage of the satellite and its components with a view to operating margins and redundancy. The greater the margins and the higher the level of redundancy, the lower the potential risk. A satellite with a high level of redundancy and high operating margins is a better risk and is likely to attract a lower rate than one with lower margins and less redundancy. One would expect the former to be less likely to cause an insurance claim. When some systems (spacecraft control processor, solar arrays, etc.) are not improved or in the past failed, they could be excluded from insurance protection.

The collective evaluation of these risk characteristics should include, inter alia, space hardware heritage. The procurement of launch services and satellites are based primarily on cost, desired performance, heritage, schedule, and insurance costs, among other things. Post space segment selection and prior to insurance procurement, the satellite owner/operator

needing to purchase insurance requires to monitor the performance of similar hardware on other programs. An excessive accumulation of anomalies and/or losses will affect the underwriters perceptions of risk/rates, and will be important to the decision on when and how to approach the marketplace. Of importance to risk control is the extent to which the owner/operator can affect control over the vendor on matters of quality control, product assurance, failure investigations and corrective actions (*Satellite Insurance Marketplace* 1999).

3. THE IDEA OF THE SATELLITE INSURANCE MARKET

In the face of the quantity of insurance markets it is impossible to describe and to assess occurring processes in an identical way. The property insurance market consists of several main classes of insurance, such as fire, marine, aviation liability, motor insurance and each group could also be differentiated to another specialized submarket. Some of them have got a satisfactory spread of risk and are self-sufficient, but others are subject to so huge expenses, that even all-year premium could not be enough to cover individual damage. This is typical of aviation, marine and oil-rig risk. A similar situation we can meet in satellite insurance, where only one failed launch devours the whole premium (Bannister 1992).

So, can we distinguish the satellite insurance market according to the criterion of the insurance products offered? Are all conditions of the existing market met in this case? On the demand side there are clients interested in buying insurance protection against satellite risk. Similarly, on the supply side there are insurers that specialize in covering such risk. Also prices are moulded by market forces – dependent on the reliability of space systems and on the scale of supply and demand. So nowadays, after many years of insuring space launches, we can say with confidence that a specialized satellite insurance market (submarket) exists. A formal definition could be like this: the satellite insurance market is the group of all buyers (demand) – consumers of insurance protection against satellite risks, and the group of insurers (supply), whose interactions create and change demand and supply, and also influence the level of prices (Manikowski 2002, p. 117).

This is an international market – on each continent there are companies that offer satellite insurance – and we can find centres of that market in Europe (London, Paris, Munich) and in the United States (New York,

Washington). The basic participants of satellite insurance market are the following entities (Lys 1999):

- insurers and reinsurers: AGF, La Réunion Spatiale, AXA Space, SCOR, Hiscox, Marham Space Consortium, ACE, etc.;
- brokers: International Space Brokers, Aon Space, Willis Inspace, Marsh Space Projects, etc.;
- manufacturers: Alcatel Space Industry, Daimler Chrysler, Marconi Space, Space Systems Loral, Boeing, Aerospace, Lockheed Martin, etc.;
- launching agencies: Arianespace, Boeing, International Launch Services, Sea Launch, China Great Wall, etc.;
- operators: Panamsat, Eutelsat, SES–Astra, Intelsat, Arabsat, Asiasat, Telesat Canada, Globalstar, etc.;
- users: TV stations, banks, car manufacturers, etc.

Moreover, on the demand side government agencies from such countries as the United States, Russia, Japan, China, India and from Europe – represented by the European Space Agency or by individual national agencies within Europe – could also appear in different roles. Among other participants in the market we should mention organizations that associate insurers (e.g. Aviation Insurance Offices Association, Lloyd’s Aviation Underwriters’ Association, International Union of Aviation Insurers), manufacturers and operators (e.g. Aerospace Industry Association, Satellite Industry Association) and other companies that help in risk assessment or propagate the knowledge of space research (e.g. Airclaims, Moreton Hall Associates, Aerospace Corporation, Space Frontier Foundation, American Institute of Aeronautics and Astronautics, Commercial Space Technologies Ltd.).

4. CHARACTERISTIC FEATURES OF THE SATELLITE INSURANCE MARKET

The satellite insurance market really began at the turn of the 1970s and 1980s. Some characteristic features of satellite insurance market can be distinguished (Manikowski 2002, pp. 122-123):

- a limited number of new insurance contracts (usually no more than 30);
- a very high possible amount of claims (over USD 250 million – in dual launches (two satellites launch by one rocket) even up to USD 500 million);

- the need for coinsurance and reinsurance (in comprehensive satellite insurance 10-15 big insurers or 20-30 smaller companies can participate, and sometimes even up to 100 insurers);
- the oligopolistic structure of the market (10-12 biggest insurers offer about two-thirds of capacity);
- the cyclical volatility of the basic market parameters (premium rates, claims, loss ratio, capacity, etc.) – the satellite insurance market has its unique underwriting cycle: from its origin over 20 years ago to recession and crisis (mid eighties), then a phase of revival (beginning of the nineties) till the boom (mid nineties) and again to recession and crisis (at the turn of the 20th and 21st centuries);
- a relatively small size of the market – both in terms of: (1) written premium (up to USD 1 billion – that is only about 0.4‰ of whole insurance market) and (2) few market players.

There are neither many insurers offering satellite insurance nor many clients. As there are about 30 commercial launches of satellites yearly, only so many new insurance contracts are reached. In recent years written premiums have been much lower than claims. This meant losses for insurers and the departure of some of them from the market. Others reduced their capacity in the sector. This situation is a result of many failures of operating satellites. Recently the conditions of insurance contracts have been changed, for example the exclusion from cover of generic failures (breakdowns recurrent in similar satellite's platforms). Therefore, recent years have been poor for the satellite insurance market and its condition is not good.

5. CONDITION OF MARKET

Fortunately for insurers, 2002 and 2003 were not bad. There were 64 launches in 2002, with 31 satellites being insured for an average amount of USD 150 million. There were more launch risks in 2002 than in 2001, but in 2003 there was a decrease again, with only 18 significant insured launch risks. The population of in-orbit risks is stable or slightly increasing, at around 150. The positive result in 2002 and 2003 exceeded USD 200 million, but there were some spectacular losses. At the turn of 2002 and 2003 (from November 2002 to February 2003) there were about USD 500 million of claims. Premiums for the same period were not more than USD 150-200 million at best. In 2003 the market also suffered from other satellite failures in the range of over USD 400 million and the

terrible loss of Space Shuttle Columbia, which caused a total damage of USD 3 billion (Zanetti et al. 2004).

The shuttle catastrophe should have no effect on the insurance market, since the shuttle was not insured in the commercial market. The general contractor for shuttle operations is United Space Alliance (USA), a joint venture between Boeing and Lockheed Martin. The USA is provided with indemnity from the government referred to as Clause 85-804. If there is a contractor out there who does not have the indemnity clause in effect and they are found to be at fault in any way then they could be liable for bodily injury. But there should be no liability for the physical assets (the shuttle) themselves. For the Space Shuttle, there was a small policy for Spacehab's RDM module for nearly USD 18 million, placed in the marine cargo insurance market.

Although that tragedy shows us that potential damage and potential claims arising from third-party liability could be enormous (if the catastrophe occurred above the city – like the terrorist attack on the World Trade Center on 11th September 2001). The debris of orbiter fell on a sparsely populated area on the borderland of Texas and Arizona. Mainly cars and some buildings were damaged. In total, NASA received 66 claims for property damage and loss of cattle, totaling half a million USD, due to the fact that the corridor of debris passed 15 miles south of Houston and Fort Worth. However, it also has to be said that the debris of the space shuttle Columbia did not hit or hurt a single person. According to Mr. Pastorek, General Counsel of NASA, the agency self-insures what it flies (Stahler 2003, p. 4).

While this will have a negligible effect on business, it elevates the satellite insurance market in the minds of management, which always results in many questions about safety, reliability, etc. As a consequence, tension remains high: capacity is low and rates are high. It is quite clear that raising USD 300 million of capacity on one risk is very challenging for any broker, even if it is feasible. For in-orbit risk, the available capacity is probably lower. The average launch + 1 year rates are around 20%, and 12 months in-orbit rates start at 2% and could reach 3 % or 4 % or more, depending on the health status of satellite. The average amount at risk is quite stable in time at about USD 150-200 million.

CONCLUSIONS

The satellite market has experienced challenging times in the past. After an initial period of increased rates and restrictive coverage, it has always returned to provide competitive terms and conditions. Often the rates offered by underwriters have been too low to sustain a healthy and viable market, hence the large increases in rates after an adverse event. This time the challenge for satellite underwriters is more severe than in the past. Nevertheless, the rates that are now being implemented substantially exceed the burning cost and, given the recent overall rise in insurance premiums in general, there is a good chance that underwriters will in the short/medium term return healthy profits, and this will encourage a more competitive market. Space technology should be improved and reliable all the time. Lack of breakdowns or even the very small number of them (like in year 2002 and 2003) is a chance for the satellite insurance market, for which it is important to believe that covered satellites are reliable and do not fail without any reason. This should feed through to lower rates and a relaxation of some of the tough conditions now on offer.

The satellite insurance market should survive, in spite of recent bad results. But it needs to reform itself – that can help in the proper estimation of technical rate. The market also requires a significant increase in the number of insured events (more satellites launched) – so that the accuracy of risk assessment can be improved. However, we should remember that the development of the satellite insurance market is closely related to the development of the satellite market – which can not develop without insurance protection.

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