Thinking of ordering a spacecraft? Well, you should not only look at the price tag then! **David Green**, Director, Business Development, Europe/Middle East/Asia, Lockheed Martin Commercial Space Systems (LMCSS) argues that when evaluating bids for a communications satellite system, 'hidden' outlays such as insurance and the costs of operations over the spacecraft's lifetime should also be taken into consideration.

An artist's impression of an AsiaSat satellite.

Image: Lockheed Martin Missiles & Space

The 'total cost of ownership'

Since the launch of the first commercial satellites over 30 years ago, purchasers of communications satellites have traditionally been engineers who tend to focus their procurement evaluations on technical performance of the spacecraft. Typically, two or three potential satellite manufacturing vendors were down-selected against agreed technical parameters of performance and equipment heritage.

Once the successful vendors made it through this technical gate, the operator's commercial managers negotiated the best price and terms, which resulted in the selection of the manufacturer. As long as satellites performed reliably and were relatively simple to operate, this approach worked well.

Satellites as commodities?

By the mid-90s, however, things begun to change and operators came to view satellites as a commodity - the same no matter where you bought it or from whom. Operators began to make purchase decisions, to a great extent, based on the lowest cost-per-transponder - the most bang for the buck.

This put a great deal of pressure on satellite manufacturers, which, in order to lower the cost per transponder, responded by producing larger and larger spacecraft. According to the US consultancy Futron Corporation, between 1990 and 2002 the average power of commercial satellites grew from under 2kW to over 7.5kW, an increase of 350 per cent. The number of transponder equivalents nearly doubled from 26 to 48.

To accomplish this dramatic increase in satellite power and capacity over such a short period of time, manufacturers were pressed into designing and implementing new power and propulsion systems. In principle these new technologies, which addressed a specific need, were attractive to operators and may ultimately be proven sound. However in retrospect, these

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technology developments were rushed to market with insufficient testing and resulted in significant in-orbit shortfalls and anomalies.

Launch failures have always been anticipated and planned for in the commercial satellite procurement business. In-orbit failures were rare. Unfortunately, by the late 1990s, this was no longer the case: in-orbit failures of power and propulsion systems began to occur with increasing regularity.

The total value of paid insurance claims for commercial satellite on-orbit anomalies between 1985 and 2002 was US$4.8 billion. However, in the six years alone between 1996 and 2002, on-orbit insurance claims were made for $4.0 billion, or 83 per cent of the total dollar value for all claims in the nineteen year period.

Insurance brokers and underwriters generally agree that, while the allocation of risk historically was 55 per cent for the launch vehicle and 45 per cent for the spacecraft, these numbers have reversed, with the majority of the risk now apportioned to the spacecraft. In this environment, satellites are clearly not commodities. In-orbit reliability factors are now paramount, and insurance costs understandably have become a major element in purchase decisions.

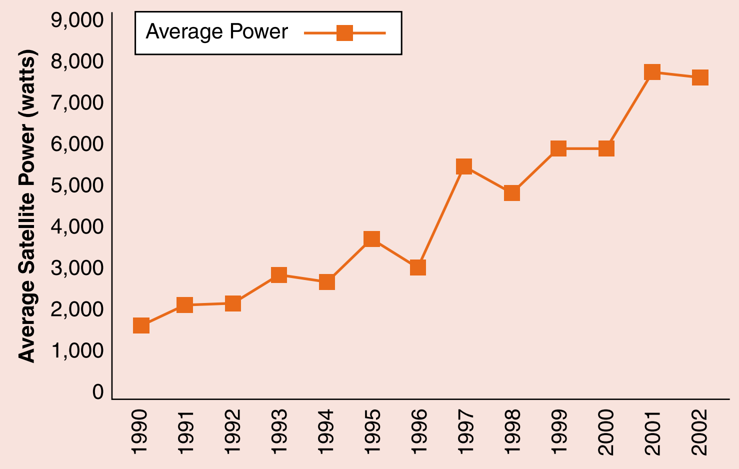
Calculating insurance cost differences

Current premiums for a basic insurance package that includes launch, post-separation, commissioning, and first year of in-orbit operation of a commercial satellite is generally in the 18 per cent to 22 per cent range. Depending on the size of the placement and capacity of the market, premiums can run even higher, with some recent placements ranging from 28 per cent to 33 per cent. For a typical $250 million placement this can translate into $45 million to $55 million cost - in addition to the purchase price of the satellite and launch vehicle - for first year of in-orbit life.

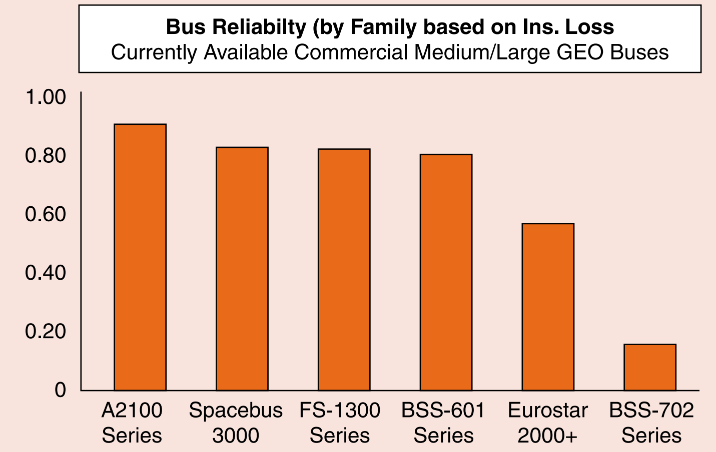
Assuming a satellite purchase cost of $100 million, an insurance rate differential between 18 per cent and 22 per cent translates to $5 million additional cost for a satellite bus with a less than stellar reliability record. Five per cent is often the purchase price difference between manufacturers.

As in-orbit failures increased in frequency in recent years, especially among certain bus types, operators became increasingly interested in protecting against such losses through in-orbit coverage. Such protection comes at a price – currently an average of 2.5 per cent to 3.0 per cent for three-axis stabilised satellites such as Lockheed Martin’s A2100. In addition, insurers will impose coverage restrictions, ie, deductibles or exclusions, for anomalies and single point failures. Now the most anticipated failure component does not have insurance coverage as insurers are requiring such components to be excluded from the in-orbit policy. A half per cent rate difference on a $100M satellite insured value, over a 14-year operating life, results in a $7 million cost difference in addi-

The relentless increase of satellite power



Bus reliability rate based on insurance claims/losses



> "Satellite reliability is now the most critical component of the insurance risk assessment. Most important to this equation is the degree to which a satellite has a proven record of successful flight and in-orbit operation.

tion to the $5 million first year purchase cost delta. Even discounting for the time value of money, this significant insurance cost difference more than offsets the cost difference in purchase price between the manufacturers.

Satellite reliability

Satellite reliability is now the most critical component of the insurance risk assessment. Most important to this equation is the degree to which a satellite has a proven record of successful flight and in-orbit operation. A 2003 study by Frost & Sullivan to analyse satellite reliability and the affect on insurance premiums, found that 'simpler, leaner, more versatile design platforms have been demonstrated to be more reliable.'

Lifetime operational costs

As spacecraft increased in size they also increased in

The Telkom satellite in Acoustic Test Cell at Lockheed Martin Commercial Satellite Centre, Sunnyvale, Ca.

Photo Credit: Russ Underwood, Lockheed Martin Missiles & Space

Typical costs of satellite operations by size of fleet

	Annual Staff Costs per Satellite	15-Year Staff Costs per Satellite	Infrastructure Costs per Satellite	Total Operating Costs per Satellite
Small operators (1-2 satellites)	$1.25M - $1.5M (outsourced)	$18.75 - $22M (outsourced)	- (outsourced)	$18.75 - $22M (outsourced)
Mid-sized operators (3-12 satellites)	$0.4M - $0.75M	$6M - $10M	$3M - $6M	$9M - $16M
Large operators (>15 satellites)	$0.25M - $0.5M	$3.75M - $7.5M	$2M - $4M	$5.75M - $11.5M

Source: Futron, 2003

complexity, placing more technical and operational requirement on the operator. Ongoing operations and programme management costs such as staff, hardware and software vary greatly depending on the satellite model, according to a 2003 Futron study. ('GEO Commercial Satellite Bus Operations: A Comparative Analysis, 2003').

Futron's 'consumer report' on the commercial satellite industry found that the major components of total operations costs over the life of a satellite are those for staff and the hardware and software for spacecraft monitoring and manoeuvring.

According to the Futron report: "Operators report that their staff spend 20 per cent to 40 per cent of their time on anomaly-related activities, with the rest spent on routine manoeuvre planning, development of new procedures and preparations for new satellites." More on-board autonomy enables operators to more efficiently manage anomalies and reduce operating costs through lower staffing needs. Futron found that mid-sized operator costs vary by more than $5 million over the life of a spacecraft, depending on the satellite platform type. This translates to yet another cost to factor in the 'total cost of ownership' equation.

According to Futron: "When asked to compare the currently available buses regarding ease of operations and customer support, Lockheed Martin Commercial Space System (LMCSS) and the A2100 in particular, received the highest ratings."

By way of example, assuming a satellite purchase price of $100 million, the estimated total cost of ownership for a satellite today would be as follows:

- Launch insurance $18-$22 million;
- Present value* of on-orbit insurance over 14 year life (PV of $35-$42 million) $22-$27 million;
- Operating costs (mid-sized operator) $9-$16 million; and
- Total cost of ownership $149 – $165 million.

(*Assuming 8 per cent cost of money)

In this example, the purchase price is just under two thirds of the total cost of ownership. Insurance and operating costs account for more than one third and vary across the satellite platforms, primarily based on the reliability of each platform.

In summary, insurance costs have increased dramatically and the rates for different satellite platforms have diverged, particularly for in-orbit insurance costs, while the growing cost of satellite operations relative to different bus types has been analysed and quantified. In view of these sea changes, it is now essential that satellite purchasers include risk and operations managers in their vendor evaluations.

Just as importantly, operators must factor underwriting and in orbit operations costs into their review and selection of a satellite manufacturer. The end result will be sound decisions that truly account for the 'total cost of ownership'. ■

Operator evaluation of ease of use and customer service of currently available 3-axis stabilised satellite bus types

Source: Futron, 2003