An Analysis of Long-Term Agreements with Suppliers in Lockheed Martin’s Commercial Satellite Systems Division

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Summary: Lockheed manufactures satellites using a combination of in-house manufacturing, purchasing, and subcontracting (for subcontract parts). The subcontract parts constitute a majority of a satellite’s costs. Lockheed uses contracts and other supply management techniques to stay competitive and to keep satellite, specifically subcontract part, costs under control. The subcontract part contracts are called long-term agreements (LTA). This study found that LTAs, when feasible, can provide cost and process advantage. LTAs are very flexible contracts and, thus, LTAs are ineffective if not priced right. The research suggests that a good LTA price falls within the range of spot price minus supplier’s LTA process savings and a normalized spot rate plus contractor’s LTA process savings.

Introduction

A satellite is defense article that is also International Traffic in Arms Regulations (ITAR)-protected. And thus, satellite manufacturers divide all satellite orders, and consequently customers, into the following two categories: commercial and government.

This study focuses on the commercial customers. These customers buy satellites using competitive bids and, if delivery schedule is met, price is the single most important factor. A satellite price is directly determined by the raw material or subassembly costs. Thus, effectively supply management has become very critical to stay competitive in the space industry. Contractors try to secure the supply for the life of a project using long-term agreements. This helps the contractors avoid getting stalemated by lack of supplies or getting stuck with a tier two or unqualified supplier.

Lockheed uses long-term agreements (LTA) among other things, to keep the costs under check. An LTA is a supply and a pricing agreement between a contractor and a supplier whereby they agree on

KEY INSIGHTS

1. Bilateral oligopoly, a few contractors and a few suppliers per part, is the stable state for the satellite contractors and suppliers.
2. Government regulations play an important part in contractor selling and buying decisions.
3. A commercial satellite is a mature product and a commodity but there are no economies of scale.
4. LTAs provide process efficiencies; these process efficiencies and other supplier incentives can be quantified as the supplier surplus available for the contractor.
5. LTAs are implementable for standardized parts only.
prices and quantities for a certain satellite part for a certain period of time. An LTA is usually two years’ long. These LTAs are used to procure subcontract items that comprise about sixty percent of a Lockheed satellite’s raw material input costs.

The LTAs are written with price variations in mind. The supplier can renegotiate any significant raw material price changes. Additionally, the LTAs are written taking currency fluctuations into account. LTAs are re-negotiable and terminable. In that sense, these are very flexible contracts that make business easy by providing a ready and mutually agreed structure and rules of engagement. However, LTAs are feasible only when a part is reasonably standardized and when a supplier is not a monopoly supplier.

**Satellite Overview**

A satellite from Lockheed’s, a satellite integrator and a satellite manufacturer, point of view, is an assembly of the following three part types – in-house manufacturing, commodities, and subcontract parts. Specifically, the subcontract items are low volume, high costs, and long delivery lead-time items. See Figure 1 for an illustrative view of satellite part types.

![Figure 1. Satellite Assembly](image)

**Satellite Systems Supply Chain**

The satellite systems supply chain comprises three key parties – customers, contractors, and suppliers. Customers develop requirements and submit requests for proposal to contractors. Contractors prepare the bids. The costs are obtained from LTAs, and in-house manufacturing. For a subcontract item, if an LTA is not available, the contractor sends out bids to qualified suppliers. The supplier responses feed into the final bid that the contractor makes to the customer. Figure 2 below illustrates satellite systems supply chain inter-relationships and flow. A contractor is a systems integrator at the top of the space systems manufacturing value chain. Satellite suppliers supply one or more subcontract parts. Further upstream are the tier-II and tier-III suppliers who provide fairly commoditized products to the tier-I suppliers.

![Figure 2. Key Supply Chain Layers and Activities](image)

**Distinguishing Features of the Supply Chain**

1. Each satellite is a unique product; each satellite is designed to manufacture. Most satellite subcontract parts are design sensitive and have to be ordered during the manufacturing process. This affects and shapes the supply chain design.
2. Satellite hardware, once it is launched, is not accessible for repair. And thus, a lot of spare capacity is built to fail-proof a satellite. This extra capacity, like extra reflectors, adds costs to an already expensive satellite.
3. Switching costs associated with changing to another supplier are very high. There is an immediate and direct cost, that of searching for new suppliers and qualifying them but also indirect costs that include the costs related with training the supplier and reaching a relationship of a desired level.
4. On an average, a satellite is manufactured in a time window of about two to two and a half years. The satellite subcontract parts, individually, have about six to twelve month lead-time.
5. The satellite supply management practices are additionally shaped by a small number of suppliers located in certain geo-political landscape.
6. Regulation restricts supplier selection and creates logistical barriers that are both costly and time consuming for the contractor and supplier.

**Supply Strategy**

The satellite value chain is a bilateral monopoly: a few contractors and a few suppliers. It is a market with fierce competition, and high entry barriers across the supply chain. Price and supply risk to the satellite subcontract parts are a significant threat to stay competitive and to ensure delivery. And thus, the contractor goal becomes to better manage supply risk and part prices.

The supply risk comes from factors like higher supplier power, and scarce supply resources. It is a seesaw with supplier and contractor on either side - higher supplier power implies lower contractor power. The high supplier power can be because of monopolistic supply landscape or because of
technological advantages. Suppliers with high market power do not prefer to do LTAs. Such suppliers leave spot market as the only engagement option. This market situation comes with high supply risk. Thus, contractors should take steps to move the suppliers from high power to low power. These steps are primarily investments in the supply. Contractors’ ability to invest and strategy to avoid supply risk ensures that the satellite supply market is in a stable state only when the supplier power is low. The make buy decision for the subcontract parts can be used to save costs or as a strategic lever to keep the supplier power low. If the in-house manufacturing provides cheaper parts than the supplier then the contractors should make effort to utilize such manufacturing.

Figure 3 illustrates supply management strategy in a matrix. The lower left quadrant is the ideal position to be in for it maximizes the contractor power and profits. The best contractor strategy is to move the part-supplier combination to this quadrant.

Key subcontract part-supplier-contractor elements to consider while using the Satellite Part Supply Strategy Matrix:
1. Number of suppliers: single, dual/multiple
2. Availability of accurate demand forecasts
3. Supply risk
4. Supplier cost data: an information advantage like knowing the supplier cost of raw material inputs can be used as a negotiation lever
5. Switching costs from the contractor’s and from the supplier’s perspective
6. Supplier’s dependence on the contractor in terms of the total business volume percentage. The more the dependence the better for the contractor. Higher dependence is equivalent to captive capacity whereby double marginalization can be avoided and at the same time most of the channel profit can be kept by the contractor
7. Part complexity, standardization
8. Supplier technological or innovation position

A Framework for LTAs

LTAs discount prices by removing process inefficiencies. However, these benefits are not guaranteed. The ease of business can become a nightmare if there are too many design changes for a subcontract part and, subsequently, the supplier start asking for additional compensation. If the currency exchange rate fluctuates too much, or if the supplier raw material costs swell, the supplier may start asking for money that was not budgeted for this project. The net result may be unexpected project cost overruns and strained business relationship. And thus, our understanding is that LTA price is not the least price that can be negotiated but a price that is less prone to risks listed above.

The LTA price calculation is based on the hypothesis that future spot rates, when appropriately transformed, provide the best estimate for LTA price. Our proposed LTA framework is a sum total of data analysis framework and price calculation framework. The data framework is applied both to the LTA data and to the spot market data. Figure 4 illustrates the data framework elements that can be used to capture present and historical LTA and spot data. This data can then be analyzed to ascertain contractor-supplier strategic position and to arrive at total relevant cost for both spot and LTA. The framework consists of five component matrices that capture critical transactional and analytical data usable for strategic and tactical LTA decisions.

One key element of this framework is normalization factor. Normalization factor is a probabilistic estimate of a supplier requesting price changes due to commodity prices increases, currency exchange rate fluctuations, part design changes, or other supplier reasons. Total landed cost versus the LTA price is intuition behind the variable normalization factor. A normalization factor when multiplied with the LTA (or spot) price tells the total expected cost of the supplier order. Normalization factors are determined for spot market and for LTAs. These factors are then used to calculate LTA prices. A contractor can choose to maintain these factors at supplier, supplier-part, part, or at corporate level.

Total relevant cost LTA, \( TR_{CL} = LTA \text{ price} + \) currency & commodity price adjustments + design change costs
Total relevant cost spot, \( TR_{CS} = \text{spot price} + \) design change costs
Normalization factor LTA, NL = \( \frac{\sum TRC_L}{\sum LTA \text{ price}} \)
Normalization factor spot, NS = \( \frac{\sum TRCS}{\sum \text{spot price}} \)
\( \sum \) is over the historical data.

**LTA Price Calculation Model**

The LTA prices can be evaluated as a range whereby the contractor limits the maximum it is ready to pay for a part and the supplier limits the minimum it is ready to sell a part for.

Maximum LTA price is the price at which the contractor is indifferent between spot and LTA price. LTA and spot prices cannot be compared without an appropriate transformation. This is because the cost of executing an LTA order may not be the same as the cost of executing a spot order. The normalization factor is used to convert the LTA/spot price into the total relevant costs. The two costs thus become comparable. The total cost of executing a spot and an LTA can be divided into an additive and a multiplicative component.

The additive part is the order overhead necessary to carry out the business. This part is the process cost. LTAs reduce this cost. The LTA process cost savings for the contractor and the supplier are noted as \( \Delta_1 \) and \( \Delta_2 \) respectively. The sum of these process efficiencies, or the spread \( \Delta_1 + \Delta_2 \), is negotiating ground for an LTA price.

The multiplicative part is the part dependent on cost risk or order risk (its origin can be LTA risks or other supply related risks.) The multiplicative parts are the spot and the LTA normalization factors – \( N_s \) and \( N_L \) respectively. The total cost of executing an LTA or a spot order is expressed as total landed cost.

Total landed cost LTA, TLC_L = \( P_{LTA} \ast N_L + \Delta_L \)
Total landed cost spot, TLC_S = \( P_{Spot} \ast N_s + \Delta_S \)

where \( P_{LTA} \) is the LTA rate, \( P_{Spot} \) is the spot rate, \( \Delta_L \) is the LTA process cost and \( \Delta_S \) is the spot process cost.

A contractor is indifferent between LTA and spot order when
\[ P_{LTA} \ast N_L + \Delta_L = P_{Spot} \ast N_s + \Delta_S \]  --- equation 1

similarly, a supplier is indifferent between LTA and spot order when
\[ P_{LTA} = P_{Spot} - \Delta_2 \]  --- equation 2

The LTA price should always be more than or equal to \( P_{Spot} - \Delta_2 \) (from equation 2) for a supplier to prefer an LTA. The LTA price should always be less than or equal to \( (P_{Spot} \ast N_s + \Delta_1 ) / N_L \) (from equation 1) for a contractor to prefer an LTA. Thus, the model LTA price follows the following range –

\( (P_{Spot} - \Delta_2) \leq P_{LTA} \leq (P_{Spot} \ast N_s + \Delta_1 ) / N_L \)  --- equation 3

Steps to approximate an LTA price range –
1. Forecast future spot rates relevant for the LTA period, \( P_{Spot} \) range.
2. Find normalization factors; \( N_L \) for LTA and \( N_s \) for spot market.
3. Estimate \( \Delta_1 \) and \( \Delta_2 \), the process cost savings for the contractor and the supplier.
4. Use spot rates from step 1, normalization factors from step 2, process cost savings from step 3, and equation 3 to derive LTA rate range (highs and lows) for every spot price.
5. The LTA price highs and lows (obtained in step 4) can be averaged separately to obtain one LTA range. Alternatively, use net present value (NPV) and a suitable discount rate, and subsequently derive LTA price range from the NPV value range.

Ability to predict the future spot rates and ability to calculate supplier and contractor process efficiencies, and normalization factors is the main challenge to be able to use this model for LTA evaluations and decision.

**Conclusion**

Satellite systems is a mature industry. Government regulations limit satellite sales or the level of technology used in the satellite product. A satellite is a commodity whereby price is the only differentiator. Contractors and suppliers try to improve process efficiencies by engaging in long-term contracts for the more expensive satellite parts, the subcontract parts. LTAs are flexible contracts that provide process efficiencies; these process efficiencies and other supplier incentives can be quantified as the supplier surplus available for the contractor. If the contractor tries to extract more than the supplier surplus, LTA risks are introduced which either increase the effective contract price or make the contract un-implementable. A disadvantage of LTAs is that these agreements are implementable for standardized parts only. Thus, part standardization should be given a high priority. Alternatively, to accommodate parts with less standardization into the contract structure, contractors can explore other form of contracts; for example, fixed price plus an audit system.