Commercial Evaluation Challenges - An Optimal Decision Matrix

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To prevent diffusion of responsibility, dedicated teams should be in place for the entire duration of a project, especially for non-R&D projects. The team should be mandated to stick to sanctioned time and cost but sufficiently empowered to make minor alterations in the scope. The team may be asked to sign a performance and integrity related MoU and assured of necessary support. This should include assured funding support because old projects may sometimes gasp for funding as new priorities take over with change of key decision makers.

Introduction

The cost dimension is one of the important performance indicators in the acquisition of defence capability. Consequently, the ultimate 'mantra' in any major defence acquisition, where the price of a product is not determined solely by market factors, is to get the best value for money. Further, compared with civil-use products, defence-unique systems tend to be much more complex. Many recent weapon systems are multifaceted, multifunction, multi-mission systems that include many more specific functions and performance capabilities than predecessor programs. (Jeffrey A Drezner, 2009). The trend of increasing complexity of weapon systems can also be defined in terms of the number of interactions among sub-systems and the degree of integration of those subsystem as well as the degree of integration at the component and part level (Robert A Dietrick, 2006). Further, meeting military specifications or 'milspecs' increase the cost of a system, given the stringent requirements for expensive materials, additional testing, legal scrutiny, etc. (David S Sorenson, 2008). These dimensions of technical complexity have made the exercise of commercial evaluation an increasingly challenging endeavour.

Cost Growth linked to Quantum Growth in Technology

In general the new systems developed are more complex in terms of technology, functionality and their operational concept. However, it is the relative increase from one generation to the next that is of special interest

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((Jeffrey A Drezner, 2009). An analysis by Flyvbjerg, Holm and Buhl (2002) makes a comparison with technological development in rail, fixed link and road projects which follow a conservative evolutionary adaptation of new technology over time while in defence systems the relative increase in complexity in each successive generation is fairly large and involve much higher levels of new technology adaptation and therefore result in inherently higher levels of cost. Consequently weapon system total cost growth is higher than the normal projects. A study by Pugh brings out that the real unit production costs of defence equipment – helicopters missiles, warships, submarines increases by about 10% each year. US Government Accountability Office (GAO) in its recent report has brought out that the US Department of Defence (DOD) total defence acquisition costs for proposals in 2008 increased 25% from the first estimate. Of this research and development costs were 42% higher than the original estimates. Cost over-runs are more likely in the cases of highly innovative weapons or weapon production processes since cost estimates usually derive from previous experience in weapons and production processes that depart considerably from the past are much likely to be off estimates (David S Sorenson, 2008).

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Defence Acquisition as a Multi-Stage Process

Acquisition of defence weapons and systems is a multi-stage process, which encompasses design, and development, prototype, limited series production and series production, in service spares support, repairs and overhaul and mid life upgrade. As a result this eventually leads to a gradual monopoly like situation. Typically the risk and uncertainties are the highest at the two ends of an equipment life cycle, i.e. the design and development phase and towards the end of the technical life when technology obsolescence begins to set in. These factors have several implications for innovation, efficiency and prices. At the core of this multi-stage process is the challenge to achieve a reasonable price. The latest in the slew of acquisition reforms is use of price-based acquisition as an alternative to the prevalent cost based acquisition models by countries like United States of America. However, a study by RAND Corporation has brought out that the methodology is inappropriate because of lack of a real market structure to provide realistic pricing information.

The Price Paradigm in Defence Acquisition

Any price regime or philosophy is underpinned by the nature of the industrial

base, which supports the development and production activity. Typically the defence markets operate in a rapidly changing security environment due to which there is a sense of uncertainty about buyer requirements and performance parameters and involves much greater technological risk to develop. Scherer (1964) and Peck and Scherer (1962) distinguish between internal and external uncertainty. Internal uncertainty is uncertainty due to technological unknowns. Internal uncertainty is especially high in the design phase of a new weapon but also continues into production. External uncertainty is uncertainty in the demand for a weapon due to changes in the external threat, changes in the availability of substitute weapons and so on. An understanding of the distinctive features of defence markets will also provide a window to the nature of the price paradigm

Defence Vs Civil Markets

Defence Markets do not resemble the economists' model of perfect competition; while most civilian markets are characterized by many buyers and sellers, the market for major military unique defense items is often closer to a monopsomy/ monopoly situation. The widespread competition so important in determining price in the commercial world may not be fully functional in the market place for defence-unique weapon systems. (Mark L Lorrell, John C Graser, Cynthia R Cook 2005). Most high technology areas like aerospace, avionics, ordnance, ship-building etc are protected sectors and may also have constraints in exports and usually consist of one or a relatively few large industrial suppliers either publicly or privately owned. Firms in the defence market are more complex both vertically and horizontally. The lead firm or prime contractor may focus more effort on system engineering / integration roles, including software development rather than component and sub-system development and fabrication. So there is significant consolidation throughout the defence industry at all the tiers. (Jeffrey A Drezner, 2009)

- Characterized by Single Buyer
  In defence markets, the buying side is dominated by a Single large customer – the Government. The buyer-seller relationship is marked by asymmetries and information gaps which results in opportunism and strategic behaviour on both sides as difference in the information available to the buyer and seller accentuates uncertainty. (Hartley and Sandler, 1995)

- Politico Strategic Aspects
  The buyer operates in a political market place where procurement choices can be influenced by lobbying (Lichtenberg, 1989) Arms transaction invariably imply politico strategic aspects. The supplier nation can block a transaction or decide that certain advanced technology and related weapon systems or sub-systems should not be

released. (K Subramanyam 2005). Factors such as technology denial, export control restrictions also limit the range of choices for the buyer.

- Leverage
  Where a nation is a substantial buyer, it could exert leverage and buy from rival foreign suppliers in the world market. The presence of a defence industrial base may also enable a country to be a more informed buyer and improve its bargaining power when considering buying from aboard (Hartley 1983; Dorfer 1983).

Price Mechanism and Incentives

The pricing regime in the defence industrial sector is an outcome of how the three stages of procurement – design, development and production – are interconnected. Policy variables of selection on the basis of competition or sole source or whether part of the R&D is funded by Government can influence profitability. William P Rogerson in his seminal paper titled 'Incentives and the Defence Procurement Process (1993) has brought out that different countries ranging from USA, Western Europe to the former Soviet Union, with different economic systems have all adopted procurement systems that provide large financial rewards for successful innovations. In some countries the prospect of earning large projects or foreign sales also creates innovation incentives for defence firms

- Profitability in the Defence Sector
  Rogerson also used an event study methodology based on major aerospace programs of USA (DoD) where a number of firms competed in the design phase and there was a sole source selection phase thereafter, to observe how the stock market values of the contestants changed in response to the announcement of the winner and to use these observed changes to infer the value of the prize that the firms were competing for. According to this study, the figure assessed was between 3.3% to 4.7% of discounted program revenue. When viewed over long time horizons, the defence industry, according to Rogerson, appears to earn approximately a normal rate of return as compared to commercial industry. One reason is that between 50 and 60 percent of a weapon system is typically sub-contracted so this is a potentially significant source of entry (Gansler 1980). There is also the expanding market for retrofitting existing platforms and upgrade with improved electronic sub systems and armaments where the profit margin is equal to that of the first sale.

Techno-Nationalist Defence Industrial Strategy

Raymond Vernon and Ethan Kapstein noted nearly twenty years ago (National

Needs, Global Resources' Daedelus, Fall 1991)

"Any nation that is determined to rely upon its own products, its own technologies and its own enterprises to fulfill its defence needs will pay a far higher premium for such a policy than in years past, costs that will be expressed not only in terms of money but also in a sacrifice in the quality of its military equipment".

Some countries like, China, Brazil Japan, India South Korea and Malaysia have created a defence industrial base as a means of acquiring new technology and to achieve self-reliance and to reduce dependence on imports (Hartley and Sandler 1995). India has initiated several policy measures to provide an impetus to arms production in India. However according to 'Military Balance 2009', foreign weapon systems still comprise around 70% of the Indian military arsenal and that India has been forced continually to search for foreign equipment to compensate for delays in domestic weapons programs. It is this paradox which makes the task of finding cost effective options so critical to the acquisition process in India.

Price Format – Perceptions of Value

The commercial offer format determines the 'depth' to which various dimensions of an offer can be analyzed. Existing literature on the subject of pricing highlights that prices trigger cognitive activity and the manner in which price is presented, significantly influences perceptions of value (Bertini and Watheiu 2005).

The essence of the theories on price as a stimulus to think point to the following principles: -

- Price components presented separately activate a matching number of attribute evaluations.

- Integration of separate attribute evaluations to reach an overall assessment will be naturally biased in favour of the attributes whose prices are easier to evaluate. Attribute evaluation will receive differential weightage depending on the ability to judge it with greater confidence. This judgment is dependent upon the precision or ambiguity of the reference prices.

This theoretical construct of the principle of 'thoughtful consideration ' as a marketing strategy can be applied to the acquisition of weapon systems and platforms which involve integration of numerous technologies to counter "transgressive pricing" by defence firms . Further, in the case of defence acquisitions, analysis of multiple product dimensions also serves to maximize the bargaining strategies and tactics of the buyer. The challenge to a country

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like India, which still has a continued dependence for high technology weapons and systems through import, is to have an appropriate costing model which will serve as an effective bargaining tool and also try to bridge the asymmetries between buyer and seller.

Multiple Dimensions of the Price Format

The Defence Procurement Procedure has emphasized the need to ultimately achieve total cost of acquisition. The components, which can achieve total cost of acquisitions, are as follows: -

- Direction Acquisition Cost
- Mandatory Replacement of major components over equipment service life
- Scheduled Intermediate Level Servicing
- Depot Level Overhaul
- Operating Cost.

The Direct Acquisition Cost itself would need to be disaggregated into components to enable an analysis of multiple dimensions of the cost-build up. While these components would vary depending upon the kind of weapon system or platform, viz. aircraft (fighter / transport), helicopter, tank, artillery guns, air-defence system and so on the basic underlying elements generally can be categorized as follows: -

1) Basic Unit cost of weapon system / equipment.
2) Accessories / Role Equipment
3) Ground Handling Equipment
4) Ground Support Equipment
5) Spares package.
6) Special Machine Tools and Test Equipment, Common Tools and Testers.
7) Training, both in India and abroad, viz. Operator training, maintenance and technicians training; Training Aids, e.g. Simulator, charts etc.
8) Documentation, viz. manuals and technical literature including illustrated spares parts.

9) Technical Infrastructure cost (if required).

- Sub-System Level Assessment

  Given the complexity of the systems the basic equipment cost can be further analyzed depending upon the integration of various sub systems in a particular system / platform. Any major weapon system generally consists of several sub-systems representing a range of technologies, e.g., Electronic systems like tactical/ mission computer, radars, sighting devices, fire control systems, avionics, navigation systems, communication systems like radio sets, weapons systems like guns, missiles and related launcher vehicles for missile platforms and so on. By this process of disaggregation into discrete components, attribute evaluation with similar systems procured in the past becomes simpler. This enables the benchmark price to be based upon a realistic assessment and is vital during the price negotiation phase.

- Transfer of Technology

  The costing of Transfer of Technology will depend primarily on the range and depth of technology, which is being sought. Generally the seller will cost the ToT after factoring in the loss of business opportunity. However, for the buyer there is need to do a cost benefit analysis of how the ToT cost when amortized over an economic order quantity will impact on the unit cost at which the production agency can offer the weapon / equipment.

  The various production stages thereafter ranging from Semi Knocked Down (SKD) / Completely Knocked Down (CKD) level to Indigenous Manufacture (IM) level will need to be analyzed by taking into account the following elements of cost build-up: -

  Material cost: Imported i.e. SKD/CKD/IM Kits.
  : Indigenous.
  Labour Cost and Overheads.
  Periodical Testing and Proof Firing.
  Cost of Capital Facilities.
  Warranty.
  Profit.
  Financing Cost.

Strategies for the Buyer

Apart from the evaluation against a reference price, the price data obtained from the seller in the commercial offer format also provides an analytical framework to establish the reliability of the price band within which to negotiate the best offer through the following strategies: -

- Comparison of price components against commercially viable norms or past patterns. For example, the upgrade cost, or spares package cost can be considered reasonable if it falls within the acceptable norms.

- Assessment of the price build-up in the commercial offer with reference to prevailing economic indices and rates of escalation.

- Segregation of the cost components in terms of cost as a percentage of the total contract value for greater scrutiny of the high value segment

- Techno-commercial assessment of the level of technology particularly of certain bought out items with a view to consider more cost effective alternatives.

Optimal Decision Matrix – Practical Applications

A methodology that through application and usage has proven to reliably lead to a desired result ultimately becomes a best practice. This paper examined a sample of acquisition programs to provide a snapshot of the dynamics of analysis of the commercial information obtained through the price format. The acquisition programmes had been concluded by Ministry of Defence, India, under the 'Buy' and 'Buy and Make' Category of Defence Procurement Procedure,

- Weapon/Equipment - Helicopter

•The acquisition was for a helicopter variant with a number of improvements over the helicopters already inducted in the IAF fleet and was on a sole source basis. The cost elements were structured in the following manner: -

- Basic cost of helicopter
- Cost of Avionics, auto pilot and on-board systems.
- Cost of Role Equipment.
- Spares Support Package
- Ground Support Equipment.
- Tools, Testers, etc.
- Training

On the basis of the methodology to evaluate the offered cost against a benchmark price, cost reduction and rationalization of the offer was achieved.

Cost Analysis

The basic price was derived from the last purchase price by the Indian Government with the economic factors of exchange rate and inflation from the

datum year being factored. In addition the improvements carried out over the earlier version of the helicopter were also added. A detailed analysis of the individual elements relating to the improvement it was indicated that the cost of Heath and Usage Monitoring System (HUMS) was very high. The seller clarified that their helicopters already had an integrated system and the requirement was therefore dropped. Further, the cost of adaptation of Night Vision Goggles was reduced and it was also clarified that the technology was of the latest generation for NVG adaptation.

- The seller had based his offer on an escalation rate of over 8% based on current and expected economic conditions which was reduced to 6% for the entire delivery period

- The quantum of spares were rationalized and the prices especially where consumption was expected to be high was reduced by 10% to 45%. The cost of the support elements because of commonality with the existing IAF fleet was 16% of the total project cost which was found reasonable since the norm of new procurement is around 30% to 40%.

- A comparison with other contemporary helicopters of similar category and capabilities was on an average was found to be 86.4% higher than the negotiated price.

By this methodology of structuring the elements of the commercial offer the Buyer was able to achieve a price reduction of about 9% of the value of the commercial offer even in a sole source scenario. This is very significant as the total offered price was approximately USD 1500 million.

Weapon / Equipment - Anti Tank Guided Missile (ATGM)

The acquisition was part of a phased procurement of a large quantity of ATGM's for the Indian Army through the 'Buy' and 'Make" route. A DPSU was the designated production agency. The procurement consisted of Fully Formed, Semi Knocked Down (SKD), Completely Knocked Down (CKD) and finally component level kits for indigenous production. The phase of acquisition relates to the indigenously manufactured missile.

The cost elements were obtained in the following format: -

- Cost of Imported Material.
- Cost of Indigenous Material.
- Labour Overheads (LOH).
- Proof Firing.
- Deferred Revenue Expenditure.
- Profit / Mark-up.

A benchmark price was available as in the initial contract with Transfer of Technology; the cost of Fully Formed, SKD and CKD had been fixed.

Subsequently in the second phase the DPSU negotiated the price for some quantity of component kits. Therefore, the breakdown of prices was compared for each of the elements mentioned above.

The CNC then made a more in-depth analysis of the Labour Overheads under the following sub-heads: -

- Salaries and Wages.
- Factory Expenses.
- Depreciation.
- Corporate Share of Expenses.

These elements included in the cost were evaluated with the last price. It was observed that having obtained ToT and with the progress in indigenous production at component level, the total cost of Labour and Overheads should gradually even out. However, there was a net increase of 52% in all the above elements, which was found to be excessive and was reduced to 12%. The elements of proof firing and profit / mark-up were also rationalized.

In the initial offer there was a 27% increase in cost from the last price, which was three years old. The final negotiated price resulted in a savings in price of 15% from the original offer.

•Mid Life Upgrade of an in-Service Fighter Aircraft

The mid-life upgrade program was carried out on a sole source basis from the Original Equipment Manufacturer (OEM) and comprised of Design and Development work on some limited aircraft in the OEM's country and series upgraded of the remaining aircraft in India through Transfer of Technology. The upgrade program involved upgrade of avionics, sensors, weapons and electronics warfare suite. The OEM had provided the cost of the upgrade program as follows: -

- Main Equipment.
- Basic Aircraft up-gradation. (Structural Modification)
  - Cost of paint scheme, interiors, fixtures and seating.
  - Cost of additional avionics.
  - Cost for integration of customer specified equipment.
- Design and Development cost.
- Flight Testing in OEMs country.
- Spares Package – For Major Aggregates, Rotables, and Consumables.
- Cost of Ground Support Equipment – Tools and Testers etc.
- Training.

Cost Analysis

The cost of the above components was based on the upgraded version of the

aircraft with an escalation factor for the intervening period from the last contract. Additionally, a technology improvement factor (K-factor) was applied on certain equipments like the Radar, IR / Optical Tracking System and Head-up-Display which were markedly superior and advanced in technology.

- The high value items of the upgrade program were analyzed and negotiated to reduce the cost and in particular bought out items like Radar, TACAN, VOR /ILS RAM, etc. The cost of the INGPS (Navigation System) was particularly found to be very high and the making of the system was substituted by a more cost-effective option, which was also found to be technically suitable.

- A cost benefit analysis revealed that the cost of upgrade was generally less than the cost of a new aircraft even when total life of new aircraft is notionally reduced for purpose of comparison with an upgrade aircraft.

- For modern aircraft the cost of weapons, test equipments, spares, new infrastructure for overhaul varies between 30% to 50%. In the current program, the cost for support equipment was about 17.5% of the upgrade cost.

By this methodology of multi-level analysis of the various components of the upgrade program, reduction in cost of 18.7% was achieved, in a program the total value of which was approximately 1200 million USD as per the initial offer.

Low Level Transportable Radars along with Transfer of Technology

The acquisition was for LLTRs for the IAF with part quantity in fully furnished form (FF) and part quantity in SKD, CKD and indigenous kits to be manufactured by a designated DPSU. The acquisition was on a competitive bid issued to seven vendors. Three vendors responded and were found to be technically complaint. A separate bid was obtained from the production agency for manufacture from breakdown kits and its communications and associated equipment.

The cost elements were analyzed against available reference prices for similar radars procured in the past few years with an escalation factor to bring them to current level. The other components like communication equipment and vehicles were evaluated separately.

The Transfer of Technology (ToT) consisted of separate elements, viz.
- ToT package – Know-how and documentation.
- Royalty Charges.
- License Fee.
- Training / Technical Assistance.

The cost of the ToT package including License Fee was reduced through negotiations. The validity period of license for production was increased by five years. For the license fee for additional quantity of radars, the vendor gave two options – one of higher fixed rate without escalation and two lower variable rate with yearly escalation. Based on a cost benefit analysis, the higher fixed rate option over the entire quantity was found acceptable. This price reduction was achieved even though the initial commercial offer was lower by a margin of 32% from the next bidder.

Conclusion: Commercial Evaluation Challenges and Outcomes

The range of issues and possible methodologies to tackle them in any major acquisition program have been spelt out covering single source and competitive bids, transfer of technology, upgrade of existing platforms and indigenous production. There is no doubt that more comparative studies in a wider sample are needed to draw definitive conclusions, however, even from this representative study it is evident that certain basic premises are emerging which can be summarized as follows:

- The distinctive features of the global defence market and the specialized nature of military production underline any costing model.
- Multi dimensional analysis of cost data provides a focus to the dynamics of the negotiation process.
- The price matrix serves as a tool to evaluate the offer against a benchmark and leads to real price discovery.
- Even in a sole-source scenario, there is scope for reduction in price within a range of up to overall 20% of the commercial offer.
- Introduction of competition results in a steeper price reduction.
- The high value of major acquisition programs provides leverage to the buyer to negotiate for a better price and achieve savings even in a sole-source scenario.
- The rapidly changing technology of defence systems, which involve higher levels of technology adaptation at every phase along with the complexity of integration of the various sub systems, makes the task of the assessment of the price an increasingly meticulous exercise.

Notes:

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