A SYSTEMS APPROACH TO DEFENCE PROCUREMENT

Derek K. Hitchins, Ahmed M. Jaber and Mike R. Moulding

Abstract. The paper reports on research into how effectiveness of military systems may be calculated, in the light of recent advances in systems science and simulation methods. An alternative approach to conventional methods for calculating effectiveness is proposed. This "white-box" approach envisages a combat simulation where C^{3}I technology, human behaviours and decision-making processes are explicitly represented, including (most importantly) their many, mutual interactions. The simulation further envisages two combatants, and measures the effect that each has on the other; hence, measures their comparative effectiveness. It is possible to identify putative emergent properties, capabilities and behaviours of combatants in given scenarios and environments. It is also possible to adjust the (simulated) performance of pieces of technology, individually and in sets. This enables the contribution of various equipments to overall effectiveness to be both observed and optimised. Hence, it is potentially possible to identify what the performance of each equipment *should* be, to maximise overall C^{3}I effectiveness.

In particular, the research was interested in the impact of COTS on C^{3}I effectiveness within a naval domain. This was assessed by representing both combatants as having identical, bespoke technological systems, operated by identically trained and experienced personnel. Identical effectiveness then emerges from each combatant. Holding one combatant steady as a dynamic reference, a single item of equipment was changed in the other combatant from bespoke to COTS. Any subsequent change in effectiveness was attributable exclusively to that one change. It was also possible to explore the effects of continual upgrades to COTS over extended periods.

Using this white-box approach, it seems possible to approach procurement by identifying the performance and other characteristics of equipments as they contribute synergistically to overall C^{3}I effectiveness. This leads to performance measures for equipments being seen, not as individual quantities, but as interactive contributors to overall effectiveness. Since the simulation also represents costs of maintenance and support of technology, bespoke or COTS, it is also possible to determine the overall value of COTS versus bespoke on a scientific basis. The approach also enables radical tradeoffs to be explored. For instance, it may be possible to trade-off the cost of command team training against the cost of enhanced weapons.

INTRODUCTION

With the increasing complexity of, and reducing budgets for, defence procurement, there is a need to take a formal systems-scientific approach in this area. This should involve:

- Looking at the whole system where the boundaries that define the whole system are sometimes difficult to define.
- Balancing the parts to optimise the whole. Candidate parts include:
  - Performance of individual equipments, to optimise the overall defence system effectiveness, although there seems to be no universal agreement as to how effectiveness should be measured.
  - Cost of various contributing parts and of the whole.
  - Value, also of various parts, in how much they contribute to overall effectiveness.

Under present defence procurement methods:

- Procurers may consider individual equipments/weapons as discrete projects, with their responsibility being to get "the best" from the contractor(s). Unfortunately, as we shall show, getting the best for one project may act against getting the best for the whole weapon system, and may impair overall effectiveness.
- Procurers (and modellers) generally omit humans (operators, commanders, and maintainers) from the equation. In practice, however, the contribution to military success is very largely dependent on such operators and decision-makers.
- Procurers and analysts may omit real-time interactions between sensors, weapons, communications, operators, and so on, thus limiting any analysis.

There is evidently a strong case for a system-scientific approach to defence procurement. We have been researching into how that might operate, and have developed prototypical methods to address the issues. In particular, we have applied systems science methods.

PROCUREMENT

What to procure, and how best to procure it, have been major issues in defence since WWII. One major problem is that of specifying the requirements for a system many years in advance of delivery, such that it can be manufactured, supplied, supported in operation and – most important of all, perhaps – that it will operate effectively should the need arise. There is, after all, little point in procuring equipments and weapons that prove ineffective when used in anger.

Meantime, everyone would like defence procurements to cost less or at least guarantee value-for-money – however defined. This raises a major current issue – *bespoke* versus *commercial-of-the-shelf systems COTS*. Should the armed forces procure and deploy (COTS), or are they better off sticking to the traditional bespoke systems? In many ways, the dilemma is the same as that faced by a lady or gentleman who needs a new suit: