DEFENCE PRODUCTION AND ACQUISITION POLICIES: SUGGESTIONS FOR A PARADIGM SHIFT

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It is a well understood axiom that scientific progress is not easily predicted, and that in most cases, its pace has been underestimated. This can now also be said of technological progress, especially after man mastered the strength of the computer and the digital world. In 1903, the venerable *New York Times* declared that thinking about flying machines was a waste of time. This, when Aeronautical Societies (soon after men went up in balloons) had been in existence for more than five decades and flyers, especially in Germany and France, had been using gliders for quite some time. The German Otto Lilienthal, a mining engineer by training, disenchanted by balloons, wanted to replicate the free flight of birds and had been experimenting with gliders since 1869. Other well-known names who were interested in gliders were Maxim, the inventor of the machine gun, Alexander Graham Bell and Thomas Edison. The mechanics of bird flight had been closely studied by Chanute, a French-born American civil engineer, and Langley, an astronomer and head of the Smithsonian Institution. Yet the cynicism of the *Times!* But what is of significance is that the *Times* article came just one week before December 17, 1903, the day the Wright Brothers made the first heavier-than-air powered flight at the wind swept beach of Kill Devils Hill at Kitty Hawk in North

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Carolina, USA. There were other minds at work, and the Europeans, especially German scientists, had sought to tackle the problem by concentrating on the thrust and power of the engine. In spite of their dedication and earnestness, they had set about the wrong road whereas the Wright Brothers initially ignored the engine and concentrated on flight control (actually spending years studying birds in flight) and set about mastering the 'lift', 'pitch', 'roll' and 'yaw' or, as they, termed it, maintaining the equilibrium and lateral control of the machine – the subjects of the patent they filed for in 1903, and obtained in 1906. The engine itself they had left to their assistant in the bicycle shop, Charlie Taylor, who fashioned the gasoline-fired four-cylinder engine and this much after they were satisfied with their glider flights. It is another matter that those who had taken the engine-centric road achieved success elsewhere. The German Messerschmitt 163 manufactured in 1944 (preceded by the invention of the jet engine by Frank Whittle) was a rocket driven fighter good for extremely high altitudes. And this road led to the development of rocketry and space travel, putting a man on the moon in 1969, just 63 years after the first flight.

It becomes necessary, therefore, to spend time and thought on getting the fundamentals right before embarking on a difficult endeavour. A misstep can lead to huge cost overruns, not to mention wastage of time which can be incalculable. What is true for science and technology is also true for policy making, with one major difference. Whereas experimentation is the norm in scientific research, it needs to be discouraged in policy formulation.. The aforesaid technological analogy is given because of its relevance to defence manufacture – a highly technology-centred enterprise. The several strands which need to be gathered together are innovation and research; institutional and financial arrangements; encouragement by state authorities; attitudinal changes amongst regulators and procurement agencies; sharing

of resources; and, above all, government patronage which needs to be extended to all those who have the potential to contribute in this national enterprise. While all these factors are true for any enterprise, defence manufacture has its own distinctive features. These need to be recognised as they have an important bearing on how the infrastructure and processes need to be organised. Moreover, defence material needs to be understood in the context of user mastery of the equipment, battle doctrines and, above all, the strategic environment in which nations pursue their security goals. Analysing the alternatives and studying the best practices elsewhere are the tools for such an enterprise. Whereas scientific innovation and discovery can be left to the genius and dedication of individuals, policy making needs to be a structured communal exercise, within the confines of the legal and constitutional framework. This paper seeks to lay out the road which needs to be taken.

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A slight diversion may help in putting the development of the Indian defence industry in its historical perspective, at least in the modern era. The East India Company (EIC)started off as a trading company with a factory (actually a warehouse for temporarily storing goods) established at Surat, soon after getting permission to trade peacefully in India, in 1615. The number of such factories continued to grow, with nearly 23 working by 1647. However, the transfer of Bombay to the English from the Portuguese as part of the dowry of Catherine of Braganza, sister of King Alfonso VI, when she married Charles the Second of England in 1662 (actually effected in 1665), led to the English acquisition of a fort built earlier by the Portuguese. (The English had, by 1644, already completed the construction of Fort St. George on a 10-km-long strip of land obtained on lease from the Raja of Vijayanagara but unlike Bombay, Madras was a safe haven). Thus, Bombay became the site of the first manufactory established by the East India Company, a gunpowder mill built in 1669. Arsenals became

an integral part of the defensive fortifications. However, the company directors in London were averse to sharing technical knowledge for weapon manufacture with the Indian workers. But the fast pace of transformation of the company from a trading to a military power soon necessitated some minimal establishment of weapon manufacture facilities in India. A gun foundry came into existence in Fort William at Calcutta in 1770. Soon thereafter, in 1775, the Board of Ordnance was established. This centralised all control over ordnance matters, including contracting, manufacturing, laboratory testing and supply. Many mills, carpentry and smithy shops were established but traditionally Cossipore has the distinction of continuing its operations uninterrupted since 1801-02. The gun foundry at Fort William was transferred to it and it also undertook the manufacture of gun carriages. Manufacture of ordnance in India helped in territorial expansion but the First War of Indian Independence in 1857 led to a major rethink in the imperial ordnance policy which did not prefer local establishment of sophisticated military products. The fact that Indian manufacture at Cossipore was more expensive than that at Woolwich further strengthened the argument against local manufacture. There were two other factors – one, a structural change in the military establishment which amalgamated Indian regiments with the Royal Artillery and, two, the invention of the rifled gun, using steel instead of brass. Both developments mandated production of sophisticated military items in England, and import into India. This policy continued until India gained independence but the lack of knowhow continued to have its deleterious impact and, unwittingly, the policy of keeping out the private sector from defence production further compounded the problem.

As early as in 1753, the British shifted the naval dockyard from Surat to Bombay. Parsi entrepreneurs who were master builders of commercial and naval ships, prominent amongst whom was Lowjee Nusserwanjee Wadia, selected the dockyard sites in Bombay. During the course of the next hundred years, the Bombay naval dockyard built nearly 115 war vessels and 144 merchant ships, including 84 gunships for the Royal Navy. Even today the oldest British warship afloat is the HMS *Trincomalee* built in 1817. All of them used Indian teak as the basic raw material. However, ever cautious

in building modern construction facilities overseas, warship construction in Bombay was allowed to languish. Building aircraft carriers and submarines was out of the question. However, the Indian Navy, modelled on the Royal Navy pattern, had in-built design capabilities as an institutional set-up and this has been a boon. It demonstrated in addition to its design capabilities a greater propensity to collaborate with the Defence Research and Development Organisation (DRDO). It is quite significant that all the ships presently under construction are being built in Indian shipyards (including some in private shipyards also). A major milestone was reached with the launch of India's indigenous aircraft carrier (*Vikrant*) in August 2013 at Cochin Shipyard Limited. The transfer of technology arrangements under the Scorpene project enhanced the navy's design capabilities in submarine construction. Because of a separate design infrastructure embedded in the navy's institutional framework, its interaction with industry and research bodies has been more intense. Such a tradition did not exist in the army and air force, which relied, the former for its vast array of equipment, and the latter for its sophisticated airborne systems, on private enterprise or dedicated ordnance establishments outside the formal military structure.

Aerospace technologies being a 20th century innovation, never really got off the ground in India. A factory meant to produce rifles was conceived in Kanpur in 1942 but it was ultimately used for repairing and overhauling aero-engines of the Royal Air Force (RAF). The credit for the first attempt at building an aerospace industry in India goes to Walchand Hirachand Doshi. Hindustan Aircraft was started in Bangalore with the active support of the princely state of Mysore in 1940. The Government of India became a partner in 1941 and thereafter took over the company by the acquisition of a majority of shares in 1942, perhaps not being very keen to allow a private industry to continue in a strategic sector during war-time. It was renamed as Hindustan Aeronautics Limited (HAL). The factory at Kanpur was merged with HAL. (It is interesting to note that another of Walchand Industry's projects, the shipyard at Vishakhapatnam, met a similar fate and was fully converted into a government undertaking in 1961 and named the Hindustan Shipyard Limited).

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The industrial policy promulgated soon after Independence as well as the development model adopted veered towards a centrally planned model. Thus, the public sector was given prominence in industrial production, and many industries were, in fact, reserved for it, including the defence industry. The exact reasons are difficult to discern, more so because, apart from the Ordnance Factory Board (OFB), other defence related industrial establishments had been privately owned. Perhaps the ideological bias, directed more towards the civil sector, was so strong that it unwittingly absorbed the defence industry also within its ambit. Policy directions were provided by Prof. PMS Blackett, a Nobel Laureate, who was also a defence equipment innovator, who suggested a two-phased programme aimed at meeting local threats in the first instance, with attention being paid to long-term threats at a subsequent stage. His recommendations led to the formation of DRDO, a decision of considerable significance. Some concessions were made post the 1962 Chinese War on the basis of the recommendations of Arthur D. Little, the US-based management firm. The Department of Supply, set up as a part of the Ministry of Defence (MoD) was to encourage private industry but only as an adjunct to the public sector. It was to be a mere works contractor, with no substantive role envisioned for it in defence product manufacture.

Indigenous efforts which relied mainly on the OFB and the Defence Public Sector Undertakings (DPSUs) did not have the desired impact, and imports continued to rise. Moreover, there was a large import content even in the indigenously manufactured products. The result is that today India accounts for nearly 15 percent of total world imports of defence material. In the pre-1990s bipolar world, although the non-aligned position which India adopted kept it equidistant from great power politics, the bulk of

defence equipment imports was from the Soviet Union. India, consequently, did not build a robust contract management system. The industrial practices conformed to Soviet practices, with a number of advisers locally posted in India. Dedicated complexes for overhaul and manufacture were established for tanks, armoured personnel carriers and aircraft. This is not to say that Western sources were totally neglected. The UK continued to be a big supplier in the initial phases and many capital ships and aircraft carriers were obtained from its naval inventory. Post the 1962 War with China, an air defence radar network was conceived and large radars were manufactured, with technology obtained from Thomson-CSF. In the early 1990s, the break-up of the Soviet Union triggered a major shift in foreign policy and defence cooperation with a number of countries like Israel, South Africa, France, etc. was initiated. Platforms obtained from Russia were fitted with sub-systems obtained from other countries. The matrix became more complex. This, in turn, exposed weaknesses in the procurement executive.

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The US-India defence relations during the Cold War era, in which the US perceived India as very close to the Soviet Union, and India saw the US' arming of Pakistan as contributing to the tensions in the subcontinent, were marked by distrust and minimal contacts. The first comprehensive effort to define a new relationship was the army-to-army contacts put forward in 1991 by Gen. Claude Kirklighter of the US Pacific Command. This, by itself, was breaking new ground, as India had hitherto, in its defence cooperation strategy, not encouraged close contacts between Service personnel, apart from the structured courses in military academies. A more comprehensive relationship was entered into in 1995 with the signing of the "Agreed Minutes on Defence Relations between the United States and India". This

was followed up with the "New Framework Defence Agreement" of June 28, 2005. Although supplies of the AN-TPQ 37 fire-finder artillery locating radars were provided prior to this date, a host of supplies was made and continues to be made since then.

A gradual shift, with an accompaniment of procedural sophistication ensued when ideas like co-production, joint development and joint ventures started becoming commonplace. There was an increasing involvement of the production wing during the commercial negotiations to see that the depth of the technology transfer increased. However, since all these efforts were with foreign governments or Foreign Original Equipment Manufacturers (FOEMs) the earlier negotiating systems continued with little modification. Complications arose not because of the introduction of elements like 'design knowhow'; greater depth of technology, etc., but in the increase in the number of vendors and the competitive bidding process. Newer concerns related to valuation of technology and determination of life-cycle costs. Thus, the simple world of the buyer-seller relationship was getting transformed, with many considerations surfacing.

2001 was a watershed year when the reservation policy was jettisoned and the Indian private sector was allowed to participate in the manufacture of defence products, albeit with licences. The first set of licensing conditions was promulgated in January 2002. After a period of waiting and a few peremptory steps, it would now appear that initial apprehensions are over and the Indian private sector has made up its mind that it would like to match the established public sector in range and depth. Most of these enterprises are, however, looking for Joint Ventures (JVs) as indigenous knowhow for sophisticated defence products is still lacking. Emphasis shifted to purchase contracts, with transfer of technology. It was but natural for the patent holding companies to transfer as little technology as possible (and certainly no design knowhow). Thus, even with indigenous production, the 'kit of parts' continued to be brought in. In many cases, the purchase and manufacture became an obsession, with little effort being made towards indigenous development. The Advanced Jet Trainer (AJT) is a prime example. The desire to have it and seek foreign suppliers emerged

in the mid-1980s and continued for two decades. In the meantime, only one shortlisted manufacturer remained, the other having closed its production lines. Serious attempts were not made to understand the deficiencies in the system or to bring in the expertise and knowledge of those outside the public sector, when, all along, negotiations were going on with the private sector foreign manufacturers.

Post Kargil, two major initiatives were taken. They related to: (a) integration of the various agencies concerned with acquisition into a unified procurement agency, housed in the Ministry of Defence; and (b) promulgation of a more open and comprehensive Defence Procurement Procedure (DPP). Thus, the Defence Acquisition Wing was manned by officers on deputation from the armed forces, the finance experts, and the civil bureaucracy. This brought in a more purposeful approach towards procurement, with the expertise of each profession aiding the others. The DPP itself, being more comprehensive, became a better guide, envisaging different approaches to outright purchase, transfer of technology, and ship building. Policy directives were to be handed down by high level committees headed by secretaries of various departments in the MoD, with an apex committee chaired by the raksha mantri. In spite of these initiatives, it was quite apparent that old habits die hard.

The procurement executive worked on a simplified, low risk matrix. The OFB was a government owned (ironically set up by the East India Company, a joint stock company) and government managed organisation. Its operations were covered for both investment and sales under the Ministry of Defence Budget. Thus, orders were placed on a cost plus basis and supplies made after the Directorate General Quality Assurance (DGQA) quality checks. There were never any serious costing disputes. The same was true for the DPSUs. In fact, parking unspent budgetary allocations under the modernisation programme with the DPSUs against orders placed but where supplies were still to be effected, became quite common. It was also 'safe' to deal with government owned organisations as no one really questioned the amounts paid. Prior to *perestroika* and the break-up of the Soviet Union (which accounted for the bulk of the Indian modernisation expenditure), the

regime of 'political pricing' under a rupee-rouble trading pattern existed. All contracting was done on the basis of standard contracts and there was very little negotiation of any substance. The Transfer of Technology (ToT) arrangements had no design content and minimal transfer of knowhow. The system worked under an arrangement wherein a large number of sub-systems and systems were imported. Since a very large number of contracts was entered into with specified government agencies and they followed a similar pattern, a sense of complacency within the procurement executive was but natural. Another significant issue was that there was no contract with the actual manufacturing bodies (all state owned) on commercial matters. To this extent, there was a major difference in procurement from Western sources, where contracting and negotiations on commercial terms were conducted with the manufacturers directly. However, in almost all cases, the payments were in advance, through irrevocable letters of credit, on the basis of self-certification. Thus, the commercial interests of the manufacturers were safeguarded. Even after revised arrangements were entered into with the Russian Federation, commercial negotiations continued to be with government entities. What was the norm with Russian purchases was also followed for purchases from the USA. In fact, it was much simpler – there was outright purchase (or lease) and under the Foreign Military Sales (FMS) regime, the commercial negotiations were not to be held by the Indian authorities. This was to be done by the US authorities, which followed their own due diligence procedures and negotiated with the private manufacturers on behalf of the Indian government. Thus, all 'risks' associated with commercial negotiations were eliminated. Moreover, having followed the government-to-government route, there was to be no competitive bidding. What was required to be done was to carefully choose the equipment and determine the required quantities. Whenever the competitive mode was sought to be used, difficulties of one type or another arose. The negotiations became prolonged because of pricing comparisons sought to be made in an environment in which there was great opacity on price issues. There was difficulty in arriving at life-cycle costs, the nature and depth of the ToT and its cost. Unfortunately, many of the negotiations

got mired in controversies, leading to cancellations of contracts and black-listing of suppliers. In a recent development, negotiations for part purchase and later manufacture of fighter aircraft in India have been abandoned in preference for outright purchase as the delay was becoming unacceptable and was affecting the defence preparedness.

In this arrangement, there was little scope for serious differences between those responsible for 'production' and those responsible for 'procurement'. As so long as the OFB and the DPSUs had enough orders and the balance sheet was in the black, the Department of Defence Production was not very much concerned with the quantum or orders which did not come their way. In fact, the DRDO was more perturbed when products developed by them were not given due weightage. The armed forces cried foul and blamed the DRDO for its intransigence. The Production and Acquisition Wings could function in their own silos with minimum interaction.

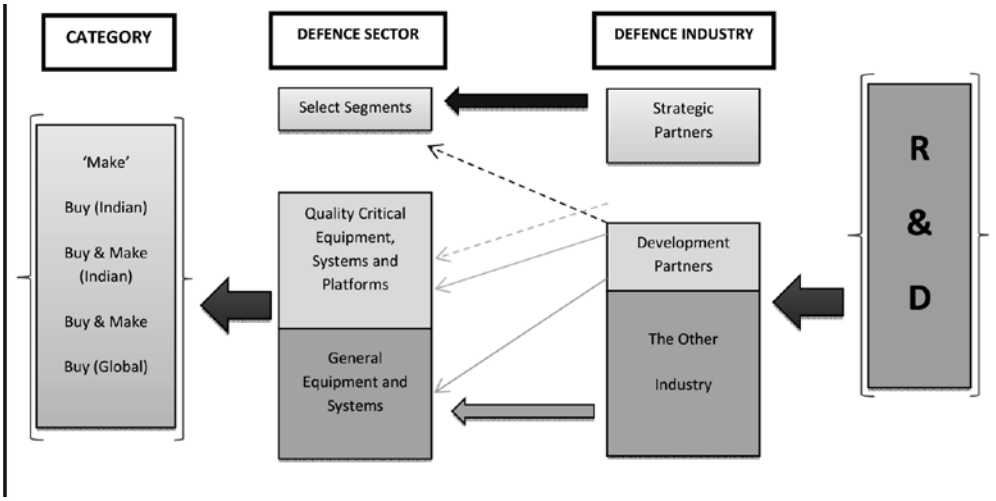
Thus, if one studies the current scenario, one sees a vast patchwork. The public sector, consisting of the OFB and DPSUs, still stands prominent in production but has little indigenous content. Government-to-government relations with the Russian Federation are still strong but the Foreign Military Sales (FMS) route with the US has fast caught up and it would appear that perhaps this route has surpassed purchases from Russia. FOEMs also belong to the UK, France, Italy, Germany, South Africa, Holland, etc. Many bilateral agreements have been entered into and each has a technology transfer content. The DPSUs are also signing up with FOEMs for Joint Venture (JV) projects. The offset regime has forced the FOEMs to search for Indian partners. The Indian private sector industry also consists of diverse elements. There are big industrial houses, which have aspirations of becoming major integrators; then, there are the Tier I, II, and III industries under the nomenclature of MSMEs (Medium, Small and Micro Enterprises) and their numbers run into thousands. Whereas a majority of them would like to be participants in the indigenisation process as suppliers to bigger companies or to the OFB and DPSUs, many of them see themselves as 'innovators', quite capable of coming up with sophisticated indigenous products or solutions. This is quite understandable and needs

to be encouraged, considering that many high technology products in the advanced countries also emanate from small companies. Everyone seems to have an idea of the macro picture but investments need hard facts. The Services made Perspective Plans and government pronouncements are not precise enough for a serious investor to start putting his money on the table. Thus, although a large number of JVs have been formed and licences obtained for diverse products, actual production, based on firm orders, is yet to commence.

The need of the hour is to remove the fog of uncertainty and to set out the fundamentals clearly. This paper commenced with such a statement and it is now proposed to spell these out. Unless this is done and done quickly, the laudable objectives of "Make in India" may not be realised and we may witness the gradual waning of interest amongst private industry for this enterprise. Such fundamentals must address not only policy parameters but also procedure and the structure and functioning of the procurement executive.

The Expert Committee set up by the government in May 2015 to suggest changes to the DPP 2013 as also to look into policy parameters, in its report of July 2015, has made wide ranging suggestions which seek to bring about a rearrangement of the patchwork mosaic and reveal the 'figure in the carpet,' so to speak. Diagrammatically, it is represented thus (Fig 1):

Fig 1



Before the proposed system is explained, it is considered desirable to spell out the building blocks on which the idea rests.

BUILDING BLOCKS FOR THE PARADIGM SHIFT

Unique Properties of Defence Material

- Whereas efficiency and reliability are the basic requirements of any product, the distinguishing feature of defence equipment is its competitive edge in extremely adverse operational circumstances. Adversaries seek not only to maintain their fighting edge but simultaneously seek to degrade the opponent's capabilities. This is not considered desirable either in civil products or in competitive sports where also winning is a prime objective. In this context, elements like endurance, stealth, built in redundancies, speed and manoeuvrability take priority and since much of these depend on the materials used, there is a constant endeavour to find more suitable materials or combinations thereof. But winning is not merely a function of technical superiority but also of skill in the use of the equipment, the logistics infrastructure, and the tactics adopted. A weakness in one of the links in this chain can have disastrous consequences.

No country would like to freely share knowhow and a restrictive technology transfer regime prevails. Thus, ToT arrangements are weighted heavily in favour of the sellers.

- It follows, therefore, that technological upgradation at a much faster pace becomes imperative. And as this happens, the training methodologies and battle doctrines need adjustments. As matters stand today, equipment manufacturers are finding it difficult to chase rapid advances in armament technology;
- The downside of this is that concomitant costs increase because of increased investment in R&D and skill upgradation of the labour employed. These costs need to be amortised over a relatively fewer number of products, thus, increasing unit costs.
- Such costs imply that at a given time, the armed forces' inventory has a mix of state-of-the-art, obsolescent and obsolete items, all requiring product support over extended timeframes.
- Specialised user trials methods require to be developed in field and laboratory conditions.

Defence Industry a Class Apart

- Order quantities of platforms and major systems are always limited and not susceptible to mass production. This also impacts on processes as batch production differs markedly from assembly line production. The basic platforms have not changed for decades, but users insist on fitting them with modern cutting edge electronics requiring considerable design work and skilled workmanship;
- This requires skills in system integration.
- The net result is that the number of viable manufacturers tends to be limited. Recent decades have seen mergers and acquisitions on a large scale in the advanced defence manufacturing nations.
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The Defence Market is Different

- Purchases being a monopsony and producers being limited, the usual market forces do not work in price determination, and other mechanisms need to be developed to ensure fairness in commercial relationships.
- Export is not always a viable option because of national or multilateral control regimes and stiff competition in the market. Order cycles are prolonged, requiring deep pockets for potential exporters.

It follows, therefore, that both the political executive and armed forces have a distinctive role in the choice of weapons. The strategic vision sets out the outer contours, and within it, the Services can and should be allowed to determine the inventory.

Hand-Holding by Government a Sine Qua Non

- Without government support, it is impossible for the private defence industry to flourish. The public sector became an obvious choice as it meant control over all aspects, including pricing. A private-public partnership ensued, and privatisation was the next logical step.
- Long-term production plans had to conform to user requirements, and industry was guided by the Services' Perspective Plans. Institutional mechanisms for constant interaction on the aspects of qualitative and quantitative requirements are required to be set up.
- Extensive facilities for user trials in field and laboratory conditions by the government need to be established and shared with producers.

Strategic Policy, Battle Doctrines and Service Qualitative Requirements (SQRs) of Defence Material to Proceed Hand-in-Hand

- Armament strength or lack of it dictates strategic policy. Many nations decide to form defence blocs to pursue strategic aims at the cost of individual autonomy. In such cases, the quantum and type of inventory is jointly decided. But for those that pursue an independent defence and foreign policy, there is a much wider choice, but this must be carefully exercised.

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Inevitability of Long-Term Partnerships

- Pursuing strategic goals is a long-term exercise and so is defence R&D and investment.
- Having invested heavily in equipment manufacture, it is necessary that exploitation is allowed over long periods, more so in the case of major platforms, which can have an active service life of more than half a century. This means maintenance, repair and overhaul facilities and upgrade capabilities.
- Thus, relationships need to be built up and maintained not only between the government and primary integrators but between the latter and tiered industries.

Emerging Diverse R&D Models and Reliance on Indigenous R&D

- Experimental models for R&D need to be encouraged till the right mix is found. Such models could span a wide spectrum, from total government funding to total reliance on private enterprise. In between these could be various combinations of government led; industry led; Services directed; wider participation of academic and specialised research, including academic institutions, etc.
- Setting up of common testing facilities and exchange of manpower between entities.

Developing the Infrastructure for Skill Upgradation

In the final analysis, all efforts must be concentrated on actual production and system integration. The skill of the workman becomes the crucial factor and the infrastructure to impart such skills and to upgrade them on a continuing basis requires to be set up.

Continuing to Strengthen the Public Sector Defence Infrastructure

The emphasis on private sector investment should in no way give rise to apprehensions that the public sector is to be neglected. As things stand, domestic production of defence items is dominated by the public sector. The physical and manpower infrastructure developed over the years is impressive and needs to be sustained. However, there is a strong case to corporatise the OFB to bring in greater efficiency and accountability, and also to affect mergers in the DPSUs, especially the shipyards.

Tested against these parameters, it would be apparent that the course taken hitherto, as described in earlier portions of the paper, in setting up a manufacturing base without the involvement of all national resources, laying down of acquisition procedures based on the wrong premises, and constituting the procurement executive without the participation of all the concerned disciplines, suffers from many deficiencies. While some aspects may require a slight tweaking, others would require a complete revamp.

Lessons can also be drawn from the experiences of other countries. A short survey is attempted here. In the United States, there are few remnants of the earlier 'arsenal system', and the country relies completely on private industry to produce high technology equipment but with parameters set up by the user Services and R&D through the aegis of DARPA (Defence Advance Research Projects Agency). Public sector involvement in defence production through the Royal Ordnance factories and dockyards was the accepted norm in Britain but a shift occurred, beginning in 1970, when the defence industry was set on the road to privatisation. The government continues to hold 'golden shares' in them, but shares are also widely held by the public. In France, one can see production units directly under government control, semi-public firms and totally private sector enterprises which are the fastest growing. However, the domestic market not being big enough to support a large production base with multiple agencies, the government has promoted consolidation of production agencies. Israel follows the French pattern of industries having different ownership structures. The security scenario having remained tense for most of the country's existence, there is heavy reliance on indigenous innovation and upgradation (of imported

hardware) skills. The South African defence industry was, to a large extent, the result of arms embargoes against it because of its domestic policies, thus, compelling indigenous effort. South Korea too is emerging as a major producer, with the government supporting designated defence contractors with specified responsibilities. Russia and China continue with state owned companies, though in Russia, the tendency is now to corporatise them for more efficient management.

Across countries, however, what is discernible is that there has been consolidation, with mergers and acquisitions, and the number of major manufacturing companies is limited. However, they are supported by a large number of MSMEs which have long-term relationships with the system integrators. In addition, small innovative enterprises have found niche markets for themselves. There is close interaction between the government and industry in R&D. Quality control is strictly monitored and self-certification is encouraged against specified standards.

What is also of significance is that in almost all countries with advanced defence technologies and a large production base, the production and acquisition executive has a unified structure for better coordination. Thus, the same authority is responsible for R&D, production and acquisition activities. Prominent amongst such organisations are the DGA (Direction Generale de L'armement) of France; and the Defence Equipment and Support Agency (DESA) of the UK. Such unified structures provide better arrangements for coordination and avoid intra-departmental conflicts. This is vital as the interests of production agencies do not always coincide with the work ethos of the acquisition agencies.

Government support and encouragement has been a distinctive feature. The zeal, industry and dedication of the Wright Brothers were matched by the support they got from established institutions. Convinced that human flight was possible and that they wanted to conduct a systematic study of the subject, they wrote in May 1899, to the Smithsonian Institution in Washington for published papers as well as a list of all other papers in the English language. The Smithsonian responded in good measure. It was also not a mere coincidence that the first flight took place 1,000 km from Dayton,

the home town of the Wright Brothers, in the wind swept beaches of a small island off the shores of North Carolina at Kitty Hawk. On queries made by them, the Weather Bureau in Washington provided details of monthly wind velocities at more than 100 Weather Bureau Stations, drawing their attention to the remote spot on the outer beaches of North Carolina. It was only after the initial successful flights that they experimented nearer home at a place some 10 km away from Dayton, at a private farm called Huffman Prairie.

There is a lot of discussion currently about innovation and start-ups. But such concepts require manoeuvrability and quick response times. Military projects tend to languish in the "prototype phase" for long periods, whilst commercial technologies are conceived of, built, and marketed, in much lesser timeframes. Even in the US, the Joint Tactical Radio System conceived in 1997 was shut down in 2012, never having moved out of the prototype mode. Innovations require flexible contracting structures. Even the DARPA system has been characterised at times as "anarchic and byzantine", although it is known to display innovative zeal such as by taking recourse to "democratised, crowd source innovation," through its cyber fast track mechanism, it made use of a talent set from amongst hackers for its cyber security initiatives. Such skills will be increasingly required in automated warfare as use of robots and Unmanned Aerial Vehicles (UAVs) increases.

Apart from such conceptual issues, there are a few matters which need attention. These relate to materials and structure of the design apparatus. Wood species like ash and spruce were preferred in the early stages of aircraft manufacture, giving way to bonded plywood. The Short Brothers, in the "Silver Streak" manufactured by them, ushered in the all metal stressed skin bi-plane. Materials now in use are aluminium, titanium and magnesium alloys, plastics and carbon composites .Use of rare earth elements contributes to distinctive metal characteristics. Thus, knowledge and knowhow of material technology becomes crucial. Likewise, the institutional mechanisms must be carefully considered and established. Various models can be adopted. Continuing with the analogy of aircraft design and manufacture, the start point can be the germination of an idea

Equipment, which requires long-term commitments for repair, overhaul, spares, and upgrades is sourced through multiple short-term contracts, requiring repeated negotiations from different suppliers.

and then working on the operational problems to get the finished product. In the early phases of aircraft design, generally, a single individual would come up with an idea and, thereafter, supervise the manufacturing process. The case of the Vickers-Armstrong Spitfire is one the most celebrated, for in this case, RJ Mitchell came up with the idea. The Spitfire was not the outcome of iterative modifications of existing types. It was an original idea spawned in the mind of an individual. Others followed, and the aircraft bear their names like de Havilland or Sikorsky. However, the sheer complexity of modern technology inevitably led to team generated designs. Such teams would include designers, engineers, works managers, and production experts. It was noticed that such team designed aircraft were less liable to develop serious faults at later stages. One immediately recalls names such as Artem Mikoyan and Mikhail Gurevich who teamed up in 1939 to form the MiG design bureau or Pavel Sukhoi who, in the same year, set up the Sukhoi Design Bureau. We have another model wherein the single designer or design bureau concept is replaced by embedding the design aspects into the corporate structure of the manufacturer either within the prime integrators or in specialised companies like engine makers. Thus, the nomenclature of the product stems from either the name of the manufacturer, or specific names given to the product by the company. So we have engines from Rolls-Royce or GE, or SNECMA and aircraft called Mirage, Hawk, F-16, etc. Such manufacturers, who need to constantly upgrade and push their products in the front lines, have to abandon the idea of producing large numbers of products of the same design and are reluctant to 'freeze' any one basic design.

Set against the building blocks identified above, one can test the current policy parameters to see whether they match up or are deficient. Certain crucial points emerge. These are:

- A misunderstanding of the nature of defence material and industry leading to adoption of a wrong template for defence procurement. The adoption of the standard procedures for civil procurement, which are characterised by multiple demands by governments and individuals of a large number of products in varying quantities and met by many manufacturers competing in the open market, as a result of multiple contracts of short duration, has completely thwarted all attempts at building up of a viable defence industry.

There is improper appreciation by industry that because of high costs batch orders and low quantities, not many major systems integrators can expect to have viable revenue streams.

- Equipment, which requires long-term commitments for repair, overhaul, spares, and upgrades is sourced through multiple short-term contracts, requiring repeated negotiations from different suppliers. This is to satisfy the requirement for transparency and price discovery through competition. Not surprisingly, India has one of the most diverse inventories amongst all the major military powers. Our airborne inventory has been sourced from Russia, the UK, France, the US, Italy, Israel and Brazil. Our sea-faring inventory is also from Russia, the UK, Germany, France, the US, and Israel. We also have products from many other countries, including South Africa, Holland, Finland, Switzerland, Ukraine, Sweden and many others. What this entails in terms of inventory carrying costs, repair infrastructure, and training facilities, is anybody's guess. The same mindset has resulted in even the OFB and DPSUs not building up a manageable vendor base.
- A viable R&D infrastructure has not been built up in which the entire intellectual expertise of the nation could be harnessed, with a proper review mechanism of on-going projects.
- There is improper appreciation by industry that because of high costs batch orders and low quantities, not many major systems integrators can expect to have viable revenue streams. Studies done by Maruti in the automotive sector, where assembly line production of a large number

of cars is the norm, has indicated that in the incubation stage, costs tend to be high and these stabilise after the process has been mastered. This is more so in high technology defence products where knowhow needs to be developed through indigenous efforts in the first place. Thus, it is surprising to witness that a large number of companies are applying for licences for a number of items. Obviously, since they do not have the knowhow, they are tying up with foreign collaborators, not always an easy task considering that there are very few manufacturers worldwide. All this not on the basis of firm orders but merely in the hope that competitive bids will fetch them some business.

- There is very little government support and sharing of common facilities. Long-term acquisition plans, along with technical specifications of equipment are not shared early enough for industries to take investment decisions. This is in marked contrast to the hand-holding pattern adopted elsewhere, with the resources of government departments made available for the asking.
- There is little integration between the Production and Acquisition Wings of the MoD. The acquisition executive still treats contracting and monitoring of contracts as the core activity. This may work in one-off contracts but is not the best methodology for the development of a fledgling industry. There is little flexibility in contract administration modelled on the civil template. The Production Wing has yet to develop procedures which will respond to the requirements of a wide range of producers. This is an important factor for MSMEs which have special requirements and are crucial as a support system. Similarly, start-ups and innovative projects require tailor-made procedures which need to be articulated and publicised.

Thus, the need of the hour is to address the deficiencies and to use the building blocks in order to bring about a major reconfiguration of procurement procedures; to do a systematic categorisation of the industry to cater to specific needs; and to revamp the structure of the procurement executive. Such a holistic exercise alone will clear up the clutter and provide

the highway towards greater productivity and self-reliance. It is time to show the path and, for the purpose, attention is drawn to the diagrammatic representation given earlier which has been suggested by the expert committee.

The way forward:

Jettison the Civil Procurement Template

The overarching recommendation of the committee is to jettison the civil procurement template as it is totally unsuitable for defence procurement. Most advanced defence manufacturing countries have adopted a different path and it is inconceivable that India can make any headway without doing so likewise. The strength of civil procurement procedures lies in its transparency which provides a level playing field to all contestants. It also provides a credible mechanism for price discovery through the operation of market forces. If an alternate mechanism has to be introduced, it must be able to satisfy the basic requirements of any procurement system. Since market forces do not apply in a monopsony, where a few suppliers are in the reckoning, the price needs to be determined by other means. This can be done through a rigorous cost audit based on mutual understanding between the buyer and seller, the methodology having been spelt out in long-term covenants entered into by the parties. This, of course, leaves the question of initial selection of the seller still open. How does one go through the selection process?

Compile a Snapshot of Existing Indigenous Capabilities

If "Make in India" has to succeed, all resources need to be engaged. Capabilities may exist across a wide spectrum, from basic repair and maintenance skills rising to system integration and design capabilities. As the industry moves up the capability ladder, Intellectual Property Rights (IPRs) of varying levels are generated. The decision to "Buy (Global)" or to "Make in India" would depend on the results of this survey. It would enable Indian industry to participate proportionately in various programmes, based on capabilities and potential. A benchmark of indigenous content

The public sector would be the natural choice because of its long standing association with these segments. The private industry would provide one more player in each unit of the six segments which the committee has identified.

will be determined, which would be gradually enhanced.

Categorisation of Capabilities

The result of this survey would lead to categorisation of industry. Those at the apex of the pyramid would have the potential to engage in construction of major platforms; smart weapons; command and control networks and complex materials. Thus, manufacture of aircraft (both fixed and rotary wings) and engines; capital ships (including aircraft carriers and submarines), armoured fighting vehicles; surface-to-surface, air-to-air, etc. guided weapons; laying down Command, Control, Communication, Computers, Intelligence, Surveillance, Targeting, Reconnaissance (C4ISTR) networks, and manufacturing critical materials like titanium and magnesium alloys would be the preserve of 'strategic partners' i.e. the industry chosen to work with the government and the armed forces on a long-term basis. The public sector would be the natural choice because of its long standing association with these segments. The private industry would provide one more player in each unit of the six segments which the committee has identified. These industries, in turn, would be supported by a larger number of smaller ones that would be chosen on the basis of the competitive model but thereafter would enter into long-term 'development partnership' relations with the prime integrators. They will specialise in quality critical equipment and will be supported in this role by the strategic partners. Such developments are already underway and we have a number of Indian industries tying up with global manufacturers as part of their supply chains. In the aerospace industry, linkages with AirBus, Lockheed Martin, Sikorsky, Ruag Aviation, Pilatus Aircraft, and Boeing have already been established. This is leading to upgradation of skills. Thus, a fledgling industry of 'development partners' is already underway. Considering the vast array of items required, there will be enough scope for the remaining industries to compete in the supply of goods

and services to the industries at the higher levels in the chain. There would be scope in the future to graduate from one level to the other. The Strategic Partners (SPs) would be required to collaborate with FOEMs, willing to share knowhow. The choice of the FOEM as that of the SPs would be that of the government acting in tandem with the armed forces.

Considering the vast array of items required, there will be enough scope for the remaining industries to compete in the supply of goods and services to the industries at the higher levels in the chain.

Choosing the Strategic Partners

Having done the general categorisation, the next step would be the choice of the SP. A robust, transparent procedure needs to be put in place wherein existing industries can compete. Obviously, the parameters on the basis of which such a competition can be held need to be developed in the absence of commercial bids based on the cost of the product, which are not feasible as none amongst Indian industry has the product. The parameters can be categorised as financial, managerial; human resources, including worker skills; production capabilities; and familiarity with industrial processes, etc. Assessment will be done on the basis of these parameters, in conjunction with field visits to facilities and meetings with management to assess their commitment to work with the government. Such parameters would need to have legal acceptance.

Some Questions Answered

Questions may arise as to whether monopolies are being created by such long-term arrangements. Apart from the fact that a public sector entity would always be a countervailing force, the space, as has already been analysed, has little scope for many players and it would not be in the national interest to give false hope that economic order quantities would be forthcoming to a number of manufacturers for all of them to have sustained profit streams. Similarly, even limited commercial bids, after short-listing, need to be avoided as the temptation to be selected as an SP can encourage predatory unviable bids.

Building a Conducive Atmosphere to Encourage R&D, and Innovation; Resource Sharing and Constant Government Support

Without these elements, a viable defence industry would be difficult to establish, considering the uncertainties and costs involved. Rigidity in procedures and unwillingness to go beyond the written word can prove disastrous.

Establishment of a Broad-Based Procurement Executive

Such an administrative arrangement only can ensure that the wings within departments do not work at cross-purposes and no critical organisation is left out. Collaboration and not antagonism should be the guiding principles. The tendency to work in water-tight silos would need to be abandoned and seamless integration forged within various departments and with industries. It follows that the Production and Acquisition Wings would have to be integrated within the same executive. This executive would have representations of industry, as also the Quality Assurance and Standardisation Directorates embedded within it. It should have facilitation desks for new aspirants and provide a virtual clearance house for information exchange. There should be seeker teams proactively scanning the industrial landscape to identify innovative ideas and companies and devising tailor-made funding mechanisms, especially for MSMEs. Management of production and acquisition needs to be recognised as a discipline, with periodic upgradation of skills of the personnel involved.

MoD Must Solicit Support of Other Departments

The MoD must seek the willing support of other departments and institutions in the matter of tax policy; funding arrangements; skill development; involvement of academic institutions; foreign direct investment and exports. Consultative arrangements need to be put in place.

It is felt that such a restructuring of the defence establishment needs to be done to remove the clutter and to channel efforts in a purposeful direction. Such a paradigm shift in policy, which is long overdue, alone can lead to greater self-reliance and convert India into a true military power.

EXECUTIVE SUMMARY

Just as in the case of scientific research and technological innovation, it is essential to clearly establish the fundamentals, so too it is in the case of policy formulation. Lack of clarity in the fundamentals can lead to sub-optimal policies, making it difficult to achieve the desired results. The production and acquisition policy for armaments in India has suffered because of this lacuna which has resulted in India still relying heavily on arms imports to further its national security goals despite many years of efforts to produce armaments indigenously. Excessive reliance on the public sector and repeated recourse to ToT from foreign equipment manufacturers has brought in complacency, and little effort towards local R&D. Similarly, adoption of the civil template for procurement of defence material, which differs widely in configuration and technological content from civil products, has led to many undesirable results. The current scenario, wherein FOEMs, the public sector, and Indian private industry (which, in turn, ranges from large producers of civil products to MSMEs) are all vying for pieces of the same pie, needs to be de-cluttered and categorised, so that the strengths of each are properly assessed and utilised. This would require jettisoning of the civil procurement template, recognition of the distinctive features of defence material, an understanding of the defence industry as it has evolved elsewhere, and the constitution of a multi-disciplinary procurement executive to handle matters of defence production and acquisition in an integrated manner.

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