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Strategy to Emerge from Technology Trap

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1. INTRODUCTION

Yom Kippur war of 1971 between Egypt and Israel is known to be the first all electronic warfare (EW). In the Gulf War of 1991, the US has deployed powerful and sophisticated electronic measures and countermeasures in such magnitude that literally no Iraqi equipment has worked in the beginning for two to three days. Gulf war gave a demonstration of the power of EW and it is a watershed in the history of war. It is clear that unless we have mastery in the field of EW, our very survival is threatened. Strategic electronics play a vital role in survival. An analysis of strategic electronics and strategy to survive are presented in this communication.

When we consider where we are, which way we are heading and which way we intend to go, it is essential that we remember the words of the first strategist, Napoleon who said, "he who does not read history is condemned to repeat it".

In UK, important military studies are conducted and reported in a journal by Royal United Services Institute (RUSI). According to its perception, all nations are caught in 'Technology Trap'[1,2]. The U S call it by a different name, Calvin Coolidge Syndrome[3].

2. TECHNOLOGY TRAP

Figure 1 illustrates the technology trap. The dots show the cost of a single US aircraft from the time of concept through prototype, evaluation and induction into service. This is shown against GNP and the Defence budget of the corresponding period. The early aircraft was made using wooden frame, tin sheet, and piano wire to control. During World War II the escalation in cost is evident, as it is quickly realised that an aircraft is a war winning machine. (Incidentally, it is Italy that first used an aircraft as war machine to drop bombs on Libya). As more and more science and technology is incorporated to make the machine more effective, it is becoming more expensive. Extrapolation from 1938 to 2020 reveals, that US cannot afford more than one aircraft of the state-of-the art. UK estimates that its economy will fail to support by the year 2000, a fleet of no more than one submarine, one aircraft and one ship. This is technology trap.

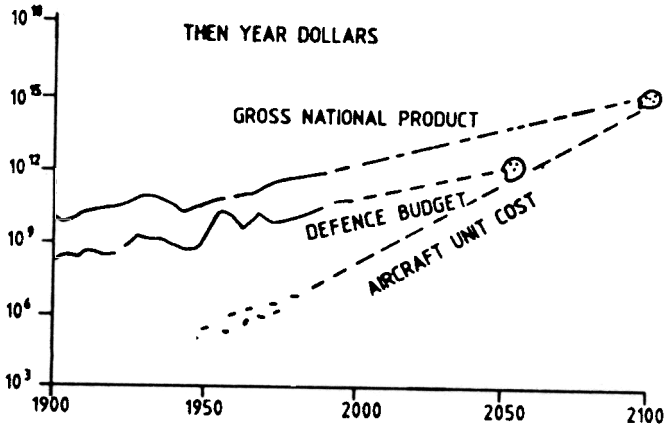

Figure 1. US tactical aircraft cost trends.

This situation has come about as a logical consequence of the fact that as each generation of new military equipment is becoming more and more capable and sophisticated, each generation is becoming less numerous. At the begining of World War II, UK had 2000 aircraft; at the end of the war the production rate

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was more than 3000 per month. Today, one may ask why one cannot have a squadron of Lancasters for the price of one Jaguar or Mirage 2000. Today's defence electronics and early warning radars on ground and in space are so advanced, that none of these Lancaster bombers will be able to reach the border, much less penetrate the defences and inflict any damage. Thus, though less in number, more advanced versions of Jaguars, Mirages and MiG 29s are essential in modern warfare.

And here lies the paradox: however effective that ultimate and expensive aircraft (few in inventory) may be, should the enemy, either by pure chance or by sheer ingenuity, shoot it down, the war is lost. This is the road to absurdity; it is on account of technology trap. On all accounts, we seem to be going down a one-way street. Calvin Coolidge Syndrome (Fig. 2) is self explanatory. It is the American view that the fighter pilots are already reaching the biological barrier, wherein, they will not be able to cope with the

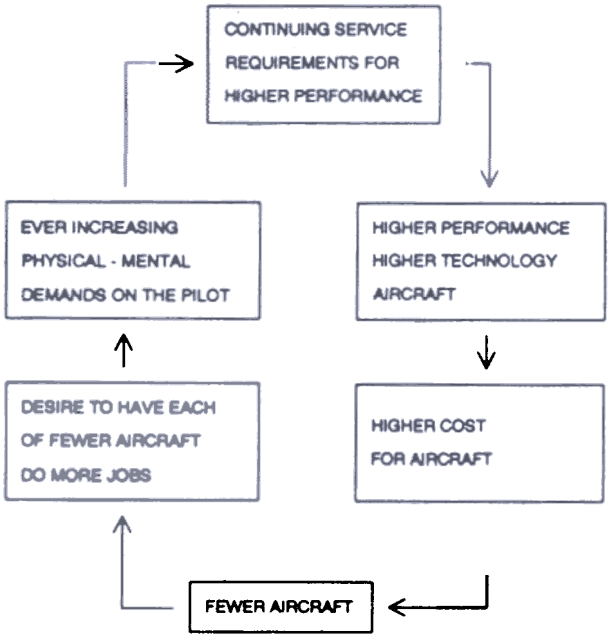

Figure 2. The calvin coolidge syndrome

impending equipment demands, information overload, and physically bear up the 'G' forces. The point may be round the corner to return to less sophisticated lower performance fighters that are more compatible with their human drivers, and put more performance into weapons.

3. THE TECHNOLOGY

There appears to be a lack of appreciation of the timelag between concept and product, even in the minds of the people connected with Defence, not to mention the public at large. Two factors related to technology are critical, and need to be appreciated. More so, as technology is accused of always delivering less, arriving late, and costing too much.

New technology and capabilities are limited by the vulnerabilities that they carry with them. Let us take a simple case to illustrate the point. From the days of Vikings and Phoenecians, sailboats were both the means of travel as well as war winning machines. Attached with a long shaft in the front, the technique of warfare used to be to ram into the enemy ships, board the vessel and combat. The fuel is free and as long as well charted coastline is in sight, long distance travel was possible limited only by the strength of the oarsmen aboard and the cannibals ashore. Come the steam engine, navigation and Naval warfare has changed. Steam engine, combined with age old Archimedes screw used as propeller, gave the ship independence from the vagaries of the weather and wind, gave speed and manoeuvrability to run, re-group and attack. This rosy picture carried with it the penalty that the ship had to carry its own fuel, and hence the range of operation was limited by the fuel and rations it could carry. The routes were tied to fuel supply lines and these needed to be defended. Soon followed colonisation for the coal and mineral mines were not near the ports. To maintain the colonies, military stepped in. Larger ships with own fuel and army needed larger displacement, resulting in larger decks where larger guns can be mounted to fire at enemy ships at farther ranges. For self protection against enemy attack, thicker armour plates were needed leading again to larger displacement and more space to keep bigger guns. The construction of Dreadnoughts however came to decline with the advent of torpedos and mines, and their days were numbered with the arrival of submarines. Naval history took a new turn. 'Thus each new innovation and technology brought with it new vulnerabilities and what was considered invincible before war suddenly became vulnerable'. History of land and air warfare is replete with similar trends.

The rate of innovation in military sphere with the application of new mathematical, material and scientific techniques is faster than the production and

development cycle can cope with. New weapons become based on obsolete technology before they enter service. 'Thus methods of mass production in short notice is as much a war winning technology as the weapon itself.'

4. WAR WINNING TECHNOLOGY

Science takes no sides. Nations driven by politico-economic considerations engage intellectuals to engineer the physical phenomena and materials to build weapons systems to win a war. A model of war winning technology is presented in Fig. 3. Of a number of such engineered versions, one becomes a decisive weapon that wins the war. Immediately; all countries acquire them in quantity and add to their inventory. Here we are confronted with a dilemma.

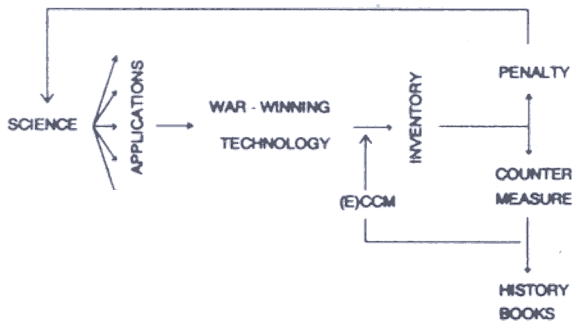

Figure 3. Model of war winning technology

Of the plethora of opportunities that science offers, how can we predict which is war winning technology? If the limited resources are invested in all promosing areas, they are spread too thinly to be effective. On the other hand, if we are choosy, we might just miss the right technology. We are aware that Patriot missile was given up as no good, and yet it saved the day in Gulf War.

As indicated earlier, each innovation carries with it a penalty and a vulnerability. The adversary may capitalise on it, make a countermeasure and make the weapon totally ineffective. This is a continuous cycle during war and peace times. It is usually during wartime, until now, that human ingenuity, and heroic acts could be traced and eulogised. It is now being shifted from the battlefield to the laboratories, where many a hero retires unsung.

It may also be seen that inventory never won a war, it only kept the war going. It is human ingenuity and innovation that decides the winner; this is war winning technology. Unfortunately this cannot be predicted. We therefore focus our attention on four factors:

(a) *Bringing together mature technologies in an innovative way is the key to war winning technology.* For example, barbed wire was war winning technology in World War I. Inspite of Gaattling repeating riffle, World War I ended up in a long drawn trench warfare. The trenches were protected by the barbed wire (developed in US to keep livestock within ranches) and effectively checked the progress of troops. It is almost at the end of the war that army could be persuaded to try a tank[2]. The idea that an automobile, which was under mass production by Ford and others for 25 years, could be converted into a tracked vehicle to run over barbed wire and bridge over trenches, changed history. The tank, which appeared almost at the end of the war at the battle front, immediately proved itself as the war winning technology. History is replete with such instances where bringing together mature technologies like barbed wire, automobile, aircraft carrier, jet engine and missile produced war winning technologies.

(b) A Wonderful equation or an invention is not enough to win a war. One can't wave a piece of paper with an equation or drawing of a weapon at the enemy and hope that the enemy would wilt, wither and vanish. *War winning technology must be backed by mass production.* Mass production capability is as important as any special weapons system. None of the weapons could have decisive effect if they were not mass produced and fielded in the theatre of war in time.

(c) 'The future is not what it used to be' is a phrase coined by the visionary. Arthur C Clarke[3]. The West is an ageing, increasingly professional, female and technologically oriented population. The Third World, with exploding population is increasingly becoming young. Their people will be largely unskilled, impoverished, and have little to hope for. It is in the Third World countries that hot spots will erupt, and *military actions will centre around low intensity conflicts.* These people will be arming themselves to the teeth, and use advanced weaponry. Not withstanding any rhetoric, and holier-than-thou attitude, some nations have great stake in keeping the conflicts

simmering, with their economics heavily dependent on the arms trade.

(d) *The hope lies in exploiting the relationship between science and economic growth.* Is the outstanding performance of scientists over the past decades the result of economic growth, or the cause of it? Robert Solow[4] (1987 Nobel prize winner for economics) has demonstrated quantitatively that economic growth does follow technological change. Further, the importance and value to a national economy of investing in the science is more readily appreciated if the exploitation of the discoveries takes place in the country of origin[5].

5. THE STRATEGY

In a rapidly changing geopolitical environment and with rapid strides in science and technology, it is presumptious to recommend a long term strategy. At the same time, due to the long gestation period of development cycle and life of weapons systems, it is necessary to have a long term plan, however flexible. Upon this contradiction, expedient measures may be judiciously superimposed. The strategy by the advantage of hindsight, is.

(a) Conceptualise, simulate and then evaluate new and novel systems, prototype and test them, produce them in limited stock, while all the time concentrating on their mass producibility. (*design for production*).

(b) Find alternate civilian use with marginal changes in either the product or the production line to make production economical.

(c) The new guy in town is *consortium*. Witness EEC to fight Japanese economic dominance, Airbus Consortium to fight other airline gaints, USA and UK, France and Sweden join to develop torpedos. Enter into collaboration/consortium, so that national economy can support reasonable defence budget and pull out of the technology trap.

6. AN EXAMPLE

A variant of Heizenberg Uncertainty Principle (like Woodward's Radar Uncertainty Principle) is associated with the publication of an idea in military matters. Let us call it Beer's 'Uncertainity Principle'[6]. The moment an idea is published it will enter public domain, it will be viewed with scepticism, discussed (if at all), and discarded as futile as it is already in public domain. The minority who use the concept and adopt it to the situation may win the war. If it is not published but aired in private, it will not be accepted because it is not published.

Be that as it may, I hazard an illustration: we have *a priori* knowledge that, (i) a fly's eye has a lens that senses a movement though an exact image is not formed—an aspect of image processing, (ii) through fuzzy logic, we can handle uncertainty, approximate and qualitative information to arrive at a fairly accurate conclusion, and (iii) we can build, and train a neural network to learn and adapt to an environment, recognise objects, etc.

We can now conceive of putting together a cluster of infrared sensors with fly's eye lens that sense movement, and radiate the information regarding the movement in a small range to a local receiver. The local receivers form a cell and a neural network can be trained to locate, identify, and track a threat day or night. The central command post can decide the course of action. Each sensor is so small that it is difficult to locate and identify. A number of them are distributed randomly so that loss of a few do not lead to catastrophic failure of the system but ensure graceful degradation. Nor will the capture of a few devices let the secret of the system out. The entire system is disposable as their capture does not affect use of the same system elsewhere. Since the number required is large, it can be made very economical through mass production. The same production line can be used for civilian purposes where each individual infrared detector can be used as intruder alarm in residences, offices, etc. They can be used for personal safety in hazardous areas. A plethora of applications can be conceived as human ingenuity is unbounded.

7. CONCLUSION

Yesterday's war winning technology enters today's inventory and inventory never won wars. Further, war winning technology is as much of mass production as that of any special weapon system.

The potential candidates for hightech war winning technologies are estimated to be optoelectronics, remotely controlled/preprogrammed/autonomous robots to operate in the forward/hazardous areas, new

material and novel methods of Stealth and signature alteration of aircraft, ships and submarines.

Night vision aids are the most significant products of post-war technology. The implication of continuous fighting for manpower, ammunition, consumption, logistics support, and vulnerability of the supply system are profound. Gulf war demonstrated the power of EW and should inspire and generate new ideas for countermeasures and war winning technologies for the future.

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