

**Institute for Defence Studies & Analyses
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**Inaugural address
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(Verbatim)**

Thank you Director General.

It is a great pleasure and honour to have this opportunity to inaugurate the first meeting of the IDSA High-Tech Defence Innovation Forum. The creation of a dynamic national eco-system to support high tech -defence innovation is a very critical and important task. India needs to have a national policy to attain control over critical technologies. This Forum needs to take a look at what is the way forward for us to move ahead on creating an innovative technological development culture.

When we look at nations that play a great-power role in the international system - we need to very clearly understand the linkages between science and technology (S&T), a vibrant S&T national culture, innovation and industrial capabilities, and dominance of world markets —which comes from the close linkage between the economic sector and a country's S&T capabilities. To be a major economic power, leadership in S&T is a fundamental prerequisite. And that in turn contributes to sound foundations for military power. To look at any one attribute in isolation would be a major fallacy as all these factors are interconnected.

There is a beautiful study by Paul Kennedy, *'The Rise and Fall of Great Powers'* and these interconnections are brought out very clearly. Most of us take the wrong lessons when Paul Kennedy states that nations fall prey to strategic overreach, focusing on only one aspect and failing in building overall national power. Like the Soviet Union did - and throughout history - various empires have done that—strategic overstretch occurs when the balance is not maintained between the economic, technological and military foundations of power and you focus on only a part of it, let us say the military part. Obviously there are pitfalls in this approach, so these historical precedents and examples have to be looked at very carefully.

But what happened to India? Why did we miss the industrial revolution? If we were leaders in the pre-industrial era, then what happened to our S&T? This is a beautiful subject for anyone who wants to research into.

India started as a young nation-state in 1947, having missed the industrial revolution and being forced to build a domestic industrial base virtually from scratch. The methodology we followed was logical—state-supported public sector unit systems, state-supported education systems and state-supported critical areas - in which we focussed on establishing the foundations for later development.

I would also like to take you back to a stage nearly 400 years ago, just before the industrial revolution, when both India and China virtually monopolised the manufacturing sector of the world. Combined we accounted for 52% of world manufacturing output, wherein India held 24% and China 28%.

So in the pre-industrial age, India's manufacturing capabilities, which were very well dispersed across the country in customised-specialist-oriented products, were of very high quality and high calibre. And that is why we had a market for our products the world over.

If I take you back another 500 years, at the beginning of the second millennia, you had great powers ruling this country. The Chola Empire spread across the seas down to Malaysia, what was then known as Kadaram. You don't conquer lands across the seas without being able to produce excellent ships that can weather and sail the vast expanses of the Indian Ocean. India had and has a great shipping industry. Some of the leading British ships were built in India in Surat in the 17th and 18th century. So you had a reasonable level of technology leadership in the world. The Vijayanagar Empire starting from the 13th to 15th century was a leader in the world in terms of not only riches and military power, but also in technology. They had actually imbibed artillery technologies from the Turks. Similarly Tipu Sultan, you are all aware of his extraordinary achievements.

But all this happened in isolated spurts. There were no interconnections between these developments and there was a break down in continuous technology education in the country. Unlike the previous millennium when you had leaders like Varahamihira and Aryabhatta and S&T was a fundamental basis of Indian culture, the system started breaking down somewhere after I

would say—the fall of the Vijayanagar Empire and the later part of the Mughal Empire.

So while you had the manufacturing leadership of the world in the 17th and early 18th centuries, we went into decline thereafter. And post-Renaissance, the Europeans focussed on freeing themselves from the strangulating control of the Church over S&T. They produced Galileo, Kaplan and others coming out with scientific breakthroughs and then Europe never looked back. And that breakthrough in technology linked to the military-industrial complex is what gave the West dominance over the rest of the world. The simultaneous decline in India and the lack of focus on science and technologies is what brought us down to the state we were in 1947. This is what needs to be addressed.

So we now have both a reason and necessity to leap frog, close the gap and accelerate at a rapid pace. Obviously we cannot go through the same process of industrial revolution—it will take another 100 years. So we have to have a leapfrogging strategy. One of the methods is reverse-engineering and licenced production, which every major advanced power has done.

To start with we had to do that—get the latest manufacturing technologies, get the latest industrial capabilities, produce under licence and learn from that process. But, simultaneously what we needed to do was to parallely start our own R&D, and then leverage large scale purchases from the international market to get the technology that we required.

To be able to do that one must be sure as to what are the critical technologies and that is where I would say the gap or even failure exists today. And this is the area that we need to debate. What are the roles of Government, the Armed Forces, the research agencies i.e., the DRDO, Industry and Academia in all this?

The government's role should be very clear - to lay down a larger strategy—identify the critical areas of technology and lay down a national strategy, and provide the guidance that needs to be in place for industry to develop. Industry's inputs should not necessarily be limited to only public sector units. On the other hand the private sector must be roped in. If we go back and analyse the American system, the USA government had laid down a national strategy on development of aeronautics in 1928! And that is a guiding principle for development.

If you analyse what Stalin did in developing Russian aerospace capability, he adopted the leapfrogging strategy and closed the gap. And by the end of World War-II, the Russians were not dependent on support of American aircraft - on the other hand they produced more than three times the aircraft acquired from the Americans. You go to Russia today - their aeronautical/aerospace industry is phenomenal, it is huge. And it has smaller industries actually controlling the critical technologies.

Even in European industry most of the critical technologies areas are outsourced from smaller industries and that is their intellectual property right.

That brings me back to the same point—we still do not have the debate on having a national aeronautical policy that started in the late 1960s-70s when Shri C. Subramaniam was the chairman of the Committee on the Aeronautics Industry. But it has never taken off. We still do not have a National Aeronautics policy.

Why am I emphasising aeronautics? There were two gentlemen - Immanuel Wallerstein and Russian economist Kondratiev who analysed the entire industrial age and how great powers achieved dominance. If you look at technology development, each technology follows a 60 to 100 year cycle. In these cycles you can identify critical technologies that are dominant technologies that have a say on world markets. It indicates that those countries that have dominance over those technologies automatically develop into great powers.

So we are into what is known as the fifth quantitative cycle and this is the cycle that is dominated by *aerospace technologies and information technologies*. Information technologies to my understanding is a sub-set of aerospace technologies, fusion technologies. So if we do not have a national strategy to be able to acquire critical technologies that compete against international benchmarking and in international markets, then you are way behind or in fact you would be losing the race. This is where strategies count.

India is seen as an emerging great power with great potential. But more needs to be done to look at technology policy in an integrated manner.

What role do armed forces play in this entire process? Armed forces must concentrate on their force structures to meet the national requirement for security, ensure that their functioning deters all adversaries and ensure also a

safe and peaceful environment for the rest of the country to develop. We ought to have cutting-edge weapons and the force structures. So obviously we have to buy wherever it is available and have it.

At the same time it is incumbent on the service headquarters to work with the government in evolving the right strategies to develop the national military capabilities and critical technologies. There is singular failure in that sphere. E.g., again I go back to the US Air-force. Almost all critical technology developments originate from the seven or eight national US Airforce laboratories which are now integrated into one single entity for administrative purposes called the Airforce Research Laboratory. Requirements that are foreseen 20-25 years hence originate from these laboratories and then, it is fed into the scientific advisory board of the US Airforce and fed into DARPA. After this development works starts with industry participation. So this is one area which the military has to look into—aiding national power development.

In the scientific community - that is the DRDO and others, we need to integrate the two—science and academia. Our Postgraduate study system must focus more on fundamental technologies and fundamental research—areas which are declining over the last 20 years. Ten years back when I visited the CV Raman Optical Institute, there were more foreign researchers that were doing research there than Indian students.

The flaw in the Indian system must be corrected and the requisite support and recognition for people who have the aptitude and interest in fundamental research must be given. A country that does not focus on fundamental research, is a country that is weak in S&T. DRDO also focuses on applied research. DRDO must focus only on critical technologies. They should not be buying technology and integrating systems and giving to the Armed Forces. Industry can combine the two to deliver weapon systems.

And finally, we took a decision on altruistic grounds to say that we will not export arms and we will not get into the arms industry for export purposes. The reality is different. All strong economies, all great powers' core strength lies in their military-industrial complex. And in S&T top-end technology lies in the military-industrial complex. Even in Japan, its strength lies in its military-industrial technological complex. It is time we start to reverse that.

The challenges are enormous. Therefore we have to work accordingly in that fashion. It is a core area. We are at a critical phase and India is an emerging

power with great potential. Remember if you want to play the role of a global power you should be able to provide the checks and balances in the international system for any other dominant power. That you can only do if you have the hard power based on control over the critical technologies.

Thank you.