Defence

Address by Mr Sharad M Marathe, President & EO, Universal Technical Systems Inc, USA

When your time starts, the green light will come on. The Co-Chairs are allocated seven minutes each. If they yield any of their time we will be grateful to them. But if they do not, that is okay. One minute before the person's time is to expire, they will get a yellow light. Fifteen seconds before the time is to expire, they will get a red light.

That is the death-wish. You do recognize that Gen Mohan Das is here from Bharat Dynamics. For those of you who do not know him, he blows people away with his missile. By the way, my congratulations to him for a very successful launch; to him and to Dr Aatre and everybody else for the launch on Wednesday. So, Gen Mohan Das has come fully equipped to help us enforce the time part of it.

If the presentation is ready, I will go through this real quick. The format today is the Co-Chairs will do their own presentations so to speak, followed by the panel presentations. The panellists will get five minutes each. When that is done, we will take a short break and our objective is that some of us want to kind of huddle what we have heard, come back out, do a Q & A and some open discussion, and then summarize it. By the way, we are hoping that this is a start of a process. This is not a one-time event and I would go in this way. Pardon me, I am not on my seven minutes right now. I am just setting the stage.

I do not want any missiles coming at me. The other thing is – our goal is, at the end of this session I was asked by Dr Aatre very rightfully so and Mr Santhanam and others as to what do we expect at the end of it. So, when you begin with a topic that is fairly abstract, not in a sense of technology but there are technology issues, diplomacy issues and so on and so forth. That is why we have two great minds here that you will get introduced to a little later – Mr Jayant Prasad who looks after our relationships with North America on the part of the Ministry of External Affairs as well as Dr Anupam Srivastava who is based in the US But the diplomacy issues are involved here that we need to, kind of, address as well. One other request – anybody who has a cell phone that is on, would you please raise your hands and would you kindly shut it off because that is the other thing Gen Mohan Das will use his missiles on – it is the cell phone rings.

What we want to do at the end of this session is to have a conceptual discussion. Many of you have probably attended other sessions before where a lot of good things get talked about and nothing happens. Maybe, a report gets written up, it collects dust and so on and so forth. Our hope and aspiration and, perhaps, fondest hope is that we will actually do something with what we are talking about and for that we need the help of all of you. So, please pitch in, not just today but going forward. This is really the first. We will have a conceptual discussion and right after that we want to get into some brass tacks, but not necessarily the projects that we want to see initiated because that is too early. None of us has done the necessary homework. But we want to talk a little bit about the nuts and bolts. So, you have a feel that you are actually serious about making something happen with this, to get some traction out of it.

So, if you hear just conceptual talk, please do not give up. We do want to get to it very, very rapidly and one of the things at the end of this session is going to be a report submitted to the Government of India. It may also be submitted to at least some people in the US Government side because of some of the issues of the diplomacy part

of technology denials and so on and so forth in this meeting, addressed in a proper framework. We want to get this thing started in a proper way and we will probably also get on the calendar of the likes of the Deputy Prime Minister in the next two or three days with him. We will sit down with him, maybe a smaller group. I will make sure that we get some quality time with him so that at the political level we get the backing that we need. Is anybody here from the Home Ministry or the Ministry of Finance? That means, Mr Gopalaswamy (Home Secretary) is in trouble because he did commit to me that some folks will come from that. But I do believe that various interests are being looked after here as well.

So, that is so much for the format and the framework for today. Is there anything else other than the slides? We talked about the time management, because I cheated, because you are ramping up the computer. We all know about the lights.

For one-to-one discussions, I am hoping, after the conclusions on the sidelines of this meeting, those of you who may have specific topics to discuss with any of the panellists etc. or with each other, please, of course, feel free to do so. But we want to encourage that. We talked earlier, of course, before lunch. The last two days, I must say, that the organizers of this event have done a fabulous job with food and I trust that they will repeat that performance here. We talked about the summary report that we hope to put out. Dr Rama Murthy, Secretary, Science & Technology, has just arrived. I wanted to recognize that. One possibility, by the way, depending upon how things shape up is that in NOIDS 28th I believe there is a Conference in Athens Gorger, at the Sam Men Forum – Sam Men was the Senator in the US Senate and headed the Defence Committee etc. So, it has got a forum started. Dr Anupam Srivastava has organized that event along with his wife, Seema Gehlot. She is somewhere in the back. But I thought was that the preceding day of that, if there is a merit and things show up, then we may do a session, maybe even inviting some US Defence people and Defence companies and so on and so forth. That is a possibility. Of course, we want to have some things here in India later on.

With that, I guess now, if you will switch my part of the presentation, we will turn on the full projection version of it. On the theme in itself – the research and development and opportunities in Defence and home line security – I was asked in April 2002 by Mr J C Sharma who is one of the key organizers and part of the Ministry of External Affairs for this event to help with the Conference per se; and the question I asked is – it is frivolous, but if you want it to be a yearly event, you must give people a reason to keep coming back and mark it on their calendar. So, this was a breakout session that I had suggested and any time you open your mouth, one of the first things you have to be careful for is you may get volunteered and I was to help get this thing organized.

In the last eight months, many of you have helped me a great deal in preparing for it, for which I am thankful. If the event is going to work, it must have an economic rationale. And everything begins with a market and the R&D things that we are talking about here, I hope, of course, that we are discussing state-of-the-art technologies that are of relevance – not technology for the sake of it, and the market share we are talking about in India – it could be in the US or other western countries or it could be hopefully in both places so that there is a way to have pay for whatever it is that we are doing.

I think, in these R&D ventures, I am picturing R&D as a business. And for a moment I want to draw a parallel to the software business. I brought with me a copy of a proposal that I submitted to the Government of India in October 1984 from which the software technology part concept got initiated. We worked day and night on it and for a long time to develop a satellite communication, there was not a single thing happening in the country and India was exporting 30 million dollars by mainly sending out people. So, the question I asked when I was encouraged to do this kind of a thing

by Mrs Gandhi and others is to say – why not 300 million dollars and why not a billion. And I was told that I was totally nuts.

Now, that may be true, and it has been many times. But actually we presented the Conference paper and the numbers did happen. Today, we are six or eight billion dollars a year; and I am doing this frankly to partly establish credibility and get a byline from you because one of the crazy thoughts I am going to put out here is – why not build this into a 500-million dollars a year business in the very near future. So, most of you would say – okay, here he goes again blowing hot air. But if you want to do this, there are a number of good partners and I hope, coming back just to the potential partners of the Indian diaspora and I believe that there is a lot of latent capabilities, desire, etc. to do something, providing technology, investments by international companies which may be looking to gain out of this, universities and so on and so forth.

The potential areas have a high relevance and you will know a lot more. Here, all over the world, it needs no emphasis per se; border management, land, air, sea, coast guard – you name it; internal security aspects of it, emergency response planning and management and I think some of them Dr Shailendra Mehta's presentation may deal with that, offences, capabilities and who does not need those? By the way, I am not a Defence R&D guy. I run a software company that makes software products so that has nothing to do and so I am not here selling anything to any of you. The technology components in all of this are things like nano-sensors that might be used in precision imaging etc., the signal processor image analysis, mathematical modelling, tree salomen detection and network technologies. Today, if you want to deal with cyber security etc. both in defence and even offensive fashion, many things come into it including the likes of data-mining which were more used in the IT, typical financial and other aspects before; parallel processing, complex project management I think Dr Aatre and others spoke earlier when we were preparing for this, and I think you would hear when Gen Mohan Das talks about it in the presentation. This is the skill that we require in India today – speciality material and so on and so forth. The list goes on.

The coming out of this might be project ideas. This is not a list of suggested projects. That is more a fruitful thought, conceived by us. The nano-sensors help you detect it much better if you have good software and all to go with it; bio-terrorism detection systems, retino-scanning systems, etc. I am hoping that later today we will be joined by Dr Bhowmick who invented the first cataract laser in the US and has done a lot of defence type of laser work for Northrop and others, micro-air vehicles again for intelligence gathering, border security, data-mining, etc. and again the security type of applications, the net assessment, rapid testing of algorithms, etc. simulation at a more robust level and so on and so forth.

The constraints, and I earlier alluded to this a little bit, are the likes of the US sanctions clause and then they have a repercussion on all the other countries that also use US technology – Britain, Germany or whatever it is. So, you get into the technology denial issues, when will you overcome the sanctions clause and other things; also establishing a mutual relationship with the countries like US and when people see there is enough common benefit, for the common interest the sanctions clause may never completely go away but we want to minimize the impact. The Government procurement culture here, if an entrepreneur wants to invest into things, they want to see action and action fast. Financial advisers within the system here, you all know about that. The distributed decision-making process and I put that in for the converse effect. I am hoping that within the Ministry of Defence and the Government of India that there would be a more centralized mechanism to deal with it.

The benefits out of this are increased security, and I am preaching neighbourhood here, but technology independence and I think that needs no further elaboration; cost savings, if the R&D is done here; building a culture of innovation, confidence-building

that we can do something in these areas and business opportunity. I hope the excitement of a challenge and a pride is there.

All I want to tell you is that there are many of us, for my business in America put food at my family's table. One of the things I look for is to have an opportunity to do something that benefits our motherland, for its defence etc. When India does something, we all feel prouder and better. So, there is an element of self-actualization, perhaps, not in everybody but certainly in a lot of people. You have to help identify who they are. I want to thank you. I hope I yield a few seconds to my successor in his presentation.

Thank you.

Address by Dr V K Aatre, Scientific Adviser to the Defence Minister

Good morning. It is a great pleasure to the talk to the Indian diaspora on a subject which is fairly close to my routine, everyday work – defence and security. If you look at the present scenario, low-intensity conflicts, insurgencies either by terrorism or otherwise, are certainly increasing. In a country like India with such a heterogeneous culture and ethnicity and psycho-social milieu, the problem is much different. Porous borders which adduce insurgency internally and the security of the border or the internal security get entangled. In India, to a large extent, internal security, because of this insurgency and porous borders, and defence cannot be separated.

That technology has a major role to play and is very important is again a cliché. So, what I am going to do is – talk to you a little bit about the Defence Research and Development Organization and use that as a platform to indicate what are our strengths and weaknesses in India, technologically or otherwise; and tell you some of the interactive modes which we have introduced and worked within my Department with NRIs and diaspora or indeed some other foreign groups.

If you look at the totality of the security scenario, sensors, systems, etc. are indeed important. You must look at slightly a broader feeling of what it is all about – intelligence gathering, surveillance, of course, weapon systems, cyber security, cy-wars, etc. All these things put together are what really give us finally internal security. DRDO is, in India, the largest R&D organization. So, I see Mr Mohanty, Gen Mohan Das and others who are going to come later and, perhaps, going to talk about the industrial aspects and the productionized aspects of what these technologies are all about. So, let me confine myself to the R&D aspects of what we do.

We operate through in a slightly different mode than the major part of the world. Mind to market, so to say, is completely done in DRDO. Conceptualization, design, development, prototyping, in some cases even limited scale production, is even done inside my laboratory. We tackle the technological issues at a much larger sense of looking at missile programmes which Mr Sharad Marathe was pointing out that we had a launch of Agni a few days back, light combat aircraft, tanks, EW systems, unmanned aerial vehicles including micro vehicles and man behind the machine, clothing, high altitude effects - because we have a range of terrain on which we have to battle – from cold deserts of Ladakh and Leh to actual deserts of Rajasthan and indeed under-water systems right in the Cochin in the southern part of India and off the North-Eastern part of India, again a mountainous, not a cold desert but a very cold climate. We have operations in Siachen, as you know.

So, I am going to talk about systems which should work in plus-45 degrees to 50 degrees and minus-40 degrees. So, the range of equipment, the range of technologies which we need for India is quite large. And a large part of that is developed in DRDO. In

fact, most of the weapon equipment R&D is done in DRDO along with our industrial partners like HAL, represented here by Mr N R Mohanty and BDL represented by Gen Mohandas.

However, in doing this over the last few years, I am not going to talk about successes, but I will tell you what are our strengths and weaknesses. I do not want to talk about software. You are well aware of what is our software potential. The strengths which we have gained in the last decade or so, in the missile system technology, aeronautics technology and electronic warfare technology are, perhaps, commensurate with ensuring the availability for India outside. The manpower in India gets generated from the academic institutions which produce enough intellectually calibred people who have flooded the pocket outside India is also very large. So, there is no dearth of manpower in India. Contrary to the assumption that you may hear that the R&D infrastructure is insufficient in India, it is a slight myth. There is enough infrastructure in India for doing any kind of R&D. I said I run a materials programme; I run a MEM's programme; we are shortly going to run a micro-UAV programme both flutting micro-UAVs and others. We have a robotics programme and I have an institute which does robotics. We have silicon foundries; we have galia-marsenite foundries. It is not for 0.3 micron technology but for 0.8 micron technology.

So, the infrastructure availability in India is pretty good. Industries in India do produce whatever we design. However, if I look at this mind to market and split it into various groups like, let us say, technology-to-product, product-to-production and production-to-market, the last two are our weak areas. Systems engineering is there. I have a very large-scale system like Light Combat Aircraft or an under-water surveillance system. We still have certain problems of looking at a very large system integration problems, system design problems. Aircraft integration is something new which we have not attempted on a large scale yet except in LCA. So, as a system design consultant, we are very good. But the totality of the nitty-gritty, a very large system, system of systems – there is still a problem.

The second aspect of weakness is really technology management and technology forecasting. India is not a technology initiator; it is a technology follower. So, we have certain problems. We have tried to address these problems by a certain kind of mutual interaction; not necessarily with NRIs or Indian diaspora. I run a joint venture programme with Russia called BRAHMOS which is a supersonic cruise missile. Both of us have funded it. There is a single management structure. Technologies flow from both the countries and we are looking for markets not only in India but outside India in international markets and Russia. I also run several programmes with American universities. I run a programme on MEMs both for under-water technology and for RF-MEMs with Penn-State University. We have signed a general MoU with other universities like Carnegie Melon; I am about to sign an MoU with it. So, that is a possibility. So, you can look at either consultancy, joint venture or programmes where you can dialogue with universities. We have run programmes like TOP-10 where the NRIs used to come and work in India. We have ILTP programmes, a long-range programme with Russia. So, there is really no limitation on what the Indian diaspora could do to India. These days, the Indian Defence Research Organization and the Indian industry are open to you. The Government has thrown open and you have got to tell us.

But one thing is there. In working under a joint programme, if it becomes a seller-buyer relationship and you do only work for my systems and I have no opportunity to work for your systems, it is going to be a non-starter. If you are going to do it, let us do it as equal partners. The first among equals could be others, but it is clearly an understanding that what we mean is finally a business but a business where there is some benefit for the equal partners. I hope by the end of the day, we will identify a

few areas and a few methodologies of working and I could provide you with details at a later stage.

Thank you very much.

Address by Mr K Santhanam, Director, IDSA

Sharad, Co-Chairs and Friends: While the power-point is getting loaded, I want to just add on to what Dr Aatre just mentioned that in this business of mind to market, it is important for the diaspora of India to understand that we have a mindful market. The user is very, very important and the user's requirements have to be defined, refined.

The second point is about technology independence that Sharad so beautifully coined a new phrase. I would imagine that in the Indian context and more so for the rest of the world, it is more technology interdependence because it will be impossible really to have the kind of autonomy or autarchy in the world today as the world is getting smaller.

Mine is about the areas of commerce in technology-added co-development. Each word is loaded; I do not have to draw pictures. I think there are three technology areas of promise and certainly of interest to us in India. You can peel the onion in various ways, but this is the way I do it. First is inclusion detection systems which are reliable, unattended, remotely-operated; could be IR, infra-red, could be micro-wave, etc. The second is terrorism tracker software for early warning purposes. Waking up after the incident is not particularly bright. And this could be after inclusion or sometimes on command, when sleepers are activated from outside. That third, I call it as NBC, nuclear biological chemical as well as explosive material system detection. Inland movement, of course, is important. It is also equally important to look into large volume air and sea cargo handling.

What could be the criteria? This is open for debate. This is just my slice. I think there must be promotion of synergy between the Indian and NRI strengths so that you seize the new day, the new opportunities that are scattered around. I cozily believe that co-development must be the primary vehicle to be used to mutual benefit. Three – we should concentrate on, what I call, pre-production technologies which are on the ramp in India as well as USA. Let me add, it is not a concept, it is not a final free-flow production. It is somewhere in between that technologies are tested; they go for a number of reasons including budget cuts.

Fourth, there must be cost and risk sharing by the partners. Of course, with Dr Rama Murthy around, I say with IPR protection. I also think that on the Indian side certainly it has to be the participation of the Government and private sector entities. It looks like on the US side; it will be essentially private companies.

What could be the possible models? I think you can have many, as Dr Aatre has mentioned just now. But let me throw out one. It can be an MoU or a contract-based partnership with agreed statement of workshop in India and USA with identified milestones. In the process of refining these and culling out a prototype or prototype plus, it is important that we come across or finalize or evolve agreed user specifications as well as acceptance test procedures – ATP – is a rock on which many projects have died – pretty good projects. If RDTE, resource development test evaluation, is successful, commercial exploitation – why not – on agreed terms through joint selection of a manufacturing firm or firms – these could be in the public or private sector in India and USA – you can have formation of joint ventures and, of course, marketing national and international.

I would like to conclude by saying that this kind of meeting is overdue, but we must have stamina so that this meeting of the diaspora is not diasporadic.

Thank you.

Observations

A couple of comments, since he is at least a minute or two ahead of the schedule which is the way I like it to be. Mr Santhanam mentioned about the acceptance test or rather test process procedures. We live and die by that in a software business. So, it does not matter what the line of business you are in if your customer's expectations are not well thought out ahead of time and what the yardstick is that you have to get with it. Things begin with euphoria and they get into frustration in the area of manager default. We want managers to work, however things may be.

The other point I do want to emphasize is that in case any of you has missed it, the last point that Dr Aatre made in his presentation, that we are looking here for partnerships, mutual opportunities, win-win, not just a buy-sell. I think it is very very critical to understand the spirit. We are potentially working on this kind of a journey. Last but not the least, I think Mr Sudhir Saxena has walked in a little while ago. Would you come to the front? He is somebody who has helped us a great deal - Sqn Ldr Sudhir Saxena. Among other things, he is a part of the IDSA think-tank and has been of a lot of help to us and for all your efforts and hard work.

The next presentation is by our Co-Chair Mr Ramachandran, the Chairman & Managing Director of Bharat Heavy Electricals Limited. It is a huge company, with huge R&D facilities etc. I think, as Dr Aatre talked about, a lot of infrastructure, a lot of facilities are there. Some things may need to be fine-tuned. But BHEL also has a great deal of facilities like that. Mr Ramachandran, by the way, is an accountant, a financial person by training and in case of BHEL. BHEL was his client at first when he was at SBI, State Bank of India. So, he knew all the inside scoops. So, when he joined BHEL, of course, he knew exactly what was going on. I think he has been a tremendous leader in the organization.

Address by Mr K G Ramachandran, Chairman & Managing Director, Bharat Heavy Electricals Limited

Very good morning to all of you. I must acknowledge that I am privileged to be participating in this session and addressing a very august gathering like this. The Indian diaspora has done the country proud. Wherever they have worked and lived, they have contributed immensely to those countries, their development in various areas including the areas of internal security and defence systems and at a time when India is seeking to attain its rightful place in the comity of nations in the globalized world that we are living in. It is indeed very topical and timely that this session has been organized. Mr Marathe has disclosed all my weaknesses; that I am a banker by background and not technically qualified or proficient. I think it is very good of him to have done that.

I would now discuss the subject that I have taken up, that is, strengths and weaknesses of the Indian industry in defence technology development. This is the subject. Till recently, as you are aware, defence production remained in the government sector and was the privy of either establishments within the Ordnance Factories or the Defence PSUs. It is thanks largely to the forward-looking attitude of our present Raksha Mantri that a policy towards privatizing the defence production was enunciated in 2001 and certain follow-up measures have taken place.

Technological innovation arising from R&D has largely been absent, especially in the defence area excepting areas where foreign technology was denied; that is, whenever there is a technology denial, India has risen to the occasion and done excellently in the area of missiles, nuclear area, etc. There, significant success has been achieved. I think the recent Agni missile launch is the last episode of that success. Otherwise, we have generally been satisfied with the absorption of imported technologies and tackling the day-to-day problems of indigenization and import substitution. Know-how and development capability has not been acquired or demonstrated and the eco-principle has generally been seen in practice, in the sense that after a few years, when a technology becomes obsolete, we go for procuring another technology.
Here, I think, like Dr Aatre correctly pointed out, the problem seems to be in terms of systems integration, systems engineering. These have been the problems. Then, taking up another weakness, I think, even after the opening up, the relatively small size of the average company in the Indian industry goes by a weakness, because the world over R&D has been concentrated in big firms, big enterprises which can afford the risk of making large investments in research and development and respective governments also have seen to help in various ways in this effort. So, in India also, there is, from the industry perspective, a need for government support so that the Indian industry is able to first satisfy India's own defence requirements. Somewhere down the line, I do feel that we need to look. I think we need to keep this upfront in our mind that the Indian industry cannot be targeting the Indian defence sector because that is not going to be sustaining. There could be gaps. As a result, I think we need to be planning for the global market. But accessing the global market may come somewhere down the line so that we have revenues to sustain the R&D expenditure which would be required.

Now, you know so much about the weaknesses. Coming to the strengths, I think, as you know, we have excellent scientific and technical manpower and skills covering almost all the fields. Dr Aatre did mention quite a few of them – excellent manufacturing facilities and production technologies are in place; excellent facilities and knowledge in the national laboratories, DRDO, IITs, R&D wings of industry and the like. Of course, India's leadership in IT is unquestioned so far.

However, strengths of facilities, knowledge, research acumen are scattered in the sense that they are domiciled in various enterprises. I think this does forebode the need for joint working, that is, a collaborative working among the various industries who have these facilities and skills to come together and work on a common platform to achieve the objective that we have. So, there is a need for collaborative working even within India as well as with the diaspora. There is a need for focussed targeted and coordinated action with mission mode working, project management skills and teamwork to tap the vast reservoir of talent and facilities that are available in different places in the country to deliver the needed defence products. I think this is the background against which the FICCI decided to set up a Defence Committee and I was honoured to be invited to chair the Committee. The Committee has started working. It is still in its early days. I do believe that the FICCI Defence Committee can play a very supportive role and also a crucial role in the interfacing of the Government for support and the coordination among the industries for other resources as such and do present a strong Indian industry forum to be able to take this subject forward and actualize the Raksha Mantri's vision that defence production needs to be privatized.

At this point of time, three private companies have obtained licences – Larsen & Toubro, Mahindras and Rolta. Apart from the Defence PSUs and, of course, the Ordnance Factories, companies like mine have been in the area of defence. I will now take the last slide. What do I believe from the industry prospective that the Indian diaspora can contribute? By way of ideas and maybe collaborative working and even funds for specific projects, promoting India as a preferred destination for sourcing of components by foreign countries for their defence requirements; using India as a development base for new technologies, prototypes, etc. help to fill the technology gaps that are there and the

FICCI Defence Committee offers to provide, as it were, a single-window service on behalf of the Indian industrial resources in this effort.

Thank you very much.

Observations

Our next presenter is Mr Natarajan. After that will be Mr Mohanty. As he gets ready to come up here, as a part of the panel, I thought I will give you just a quick introduction. He is a Mechanical Engineer, which makes me feel good. You always want to find one of your own kind in the crowd. I believe he was the brain behind the Arjun Main Battle Tank. I have to request, though, Dr Aatre that his title of Chief Controller of R&D – I hope that Dr Aatre will pursue it that they drop the word controller and turn it into promoter or some such thing. That is my fondest hope and wish you all the best for the year 2003.

Address by Mr M Natarajan, Chief Controller, R&D (ACE), DRDO

Mr Sharad Marathe, Co-Chairs, and Distinguished Guests,

Of course, I want to assure Mr Sharad Marathe that the Chief Controller – though that is the designation – we consider ourselves as Chief Facilitators of research and development for our own laboratories, sitting in headquarters and facilitating the work.

Friends, I would like to share with you some views. Dr Aatre, as the Chief of the Defence Research and Development, has given you his views on the DRDO. I have been largely a designer for almost 30 years doing research on various mechanical systems and I would like to put across some thought. In fact, this is nothing new. I had shared this earlier with some US industries again in one such forum.

Over the last two decades, we have attempted to system engineer major platforms in weapon systems – main battle tanks, light combat aircraft, electronic warfare systems and tactical missiles and rocket launchers and rocket missiles. What did we gain? Based on the experiences gained in building such systems, we see opportunities to work with US industries and, of course, here the diaspora, with possible areas of assistance which I feel would be required. One is in system simulation and optimization because quite often we get Q.R. for equipment; not for the way it has to fit into a particular system and its use. The next is details in system engineering, techniques relating to system integration and check out ATP – was highlighted here. And even in test and evaluation procedures, the test and evaluation methodologies are very, very important, particularly for the kind of terrain and the end-use that the users expect through such equipment.

There is abundant scope for most scientific and refined procedures that would substantially improve this capability to produce systems, to meet with specific requirements. As regards important technology modules, I think this is an area which may interest the gathering here – such as propulsive systems, across the board – whether it is propulsion system for automotive requirements, marine requirement, aircraft requirement, missile requirement or even in UAV and such specialized requirements; fire control systems, particularly electro-optical systems and certain specialized weapons like directed energy and such things. The work has largely been undertaken in the DRDO laboratories in view of lack of design expertise with Indian industries. But, then, we have a limitation. We cannot sweep from A to Z in one stroke. However, we have used adequately exploited them for manufacturing some assemblies and components. But even here, the capabilities of Indian industries, the system integration of technology product had to be necessarily accomplished in DRDO laboratories, notwithstanding our industries

producing a wide variety of goods for so many years.

An unsavoury part in some of these technology-intensive products has been the denial of some components and such systems from industries in the West because we had to necessarily source some – at least some – components to complete that system and this has always crossed upon and as the BHEL Chairman said, sometimes if you are told about this in the beginning, then it is a blessing in disguise. We have always succeeded in developing the product. For example, when BHEL has specifically to make diesel engines including digital management of power package possible by us, we lack fuel injection systems like rail injection. If you talk of electro-optics such as two-axis stabilized day-night systems, we can build Germanium optics, we can build day optics, but we lack thermal detector array and polygen scanners. I can go on. The list is full of a variety of such things where there are specific components or systems. If they become available, then, of course, we can complete the system and build the rest of the product in India.

There are requirements for specialized precision, terminal guidance systems featuring global positioning, milli-metric wave, laser-sick effects for our IT fabrications we have developed. We believe that we are in a position to system configure important systems which the Armed Forces require in percentage varying between 60 and 80 per cent. But we definitely need 20 to 40 per cent in the sourced, either through import or alternate through arrangements so that we can complete the system as a whole and be in a position to deliver the total goods. We have no hesitation in sourcing the parts so long as the supplies are guaranteed and we are able to work together. The Indian industrial scenario, I am afraid, you will have to appreciate that though there is a good amount of manufacturing expertise infrastructure, they had not been really technology innovators. Their expertise is largely confined to manufacturing under licence agreements and they have never gone through translating a product from development phase into the production phase. In fact, even networking of a large number of small and medium but technically competent industries is a skill-set yet to be developed by our industries. I think this is very vital if we want to build systems.

The investments in research and development have remained pitifully low in traditional manufacturing industries, notwithstanding their high turnovers. The scenario is gradually changing. Hopefully, it will change for the better. Another area of interest for us would be the methodology to work out the techno-economics of development taking all such constraints into account. Yet another area is to seek expertise relating to understanding the nuances of transiting from a development phase into engineering for production phase and finally from there on to regular production.

I emphazise this because in the defence products we see a situation where the volumes are not sufficient and you have a real problem in transiting from a functionally proven product to one of a reliable production-line product and how will we evolve if we do not have the volumes sufficient. What are the methodologies? I do not know what are the experiences in the US in this. In the US, the markets are generally very large. Our problem is again a problem of user challenge which has to be met. There are areas in an industry where we need to pick skills and expertise in techniques in diverse engineering disciplines. There would also be issues relating to ensuring quality in production line, progressive value additions, warehousing and logistics in engineering for such products and product support activities without which I do not think we can enlarge the market, hoping that a portion of the market would be exports. We have no tradition of having gone through such product support activities into the countries to whom we will be selling and they would expect us to hold Indian tree and look after them in turn so that the products are on price.

But I must say that the whole range of issues is linked to development; some linked to production and quality assurance and some linked to marketing and product support. But where I want to impress ourselves is – the duty I have seen is divided here.

Whatever we have designed for defence – in fact I felt – had I concurrently taken a product or project along with the industries whil building MBT Arjun, we would have built Mercedes Benz in this country. But we missed that opportunity. I would not like to miss that for the future.

Thank you.

Observations

Thank you. Before I request the next speaker, I have a couple of observations to make here. Yesterday, the Deputy Prime Minister Advaniji launched a new web site called *indiadevelopment.org.* One of the objectives of that web site is that it is an inbound web site where we would like to be able to put up the focus and thrust areas of interest to the country and we want you, folks, to come and register themselves, identify their skill sets and their desires. Do they want to just help, do they want to invest, do they have unique technology and so on and so forth? Therefore, a bit of a marriage brokering can take place.

I would like you to think about that web site. I think it will take some time until it gets seeded and gets built up. It is not the typical Yahoo or that kind of a web site. But it may address some of the issues that earlier you talked about that when you get the fuel injection there is a specific sub-set that you are looking for in the fire control systems or propulsion systems or whatever it is.

It is *www.indiadevelopment.org.* Please tell your friends also, at least those friends who have some good skills and skill sets and who care. We really do not want that web site to have loads and loads of people registering themselves. It is not that we object to it But what we want is those key players. And Prof Rama Murthy who is the Secretary of Science and Technology; I hope when he gets a chance he will explain. He also had a vision to develop a site like that. I think that combines the activities that would be great and I really appreciate his joining up here.

One other theme that I have been hearing is – just walking in is Mr Jagdish Sharma, J C Sharma – and he is the brain behind the whole diasporic engagement and the Secretary, Ministry of External Affairs – a very dear friend. Jagdish you used to be the Consul General of India in Chicago. I know I have had many lunches at his house. So, Jagdish, I owe you a lot.

But, by the way, our thanks to you for making this whole Conference happen. I think, any time, it is a first of a kind event. It takes a lot of blood, sweat and tears and I am sure he has shed a lot of tears so far. I hope that those of us who can, will want to help him, take the feedback from the first one and make the next one even much better.

I have one or two personal comments to make and I would like to introduce my wife, Kumi, who is here. She has put up with an awful lot of my nonsense for many years, long nights, phone calls, this and that and she has been a terrific partner in the process. Visiting with us is Priya Sharma from Boston. Priya's father, Suresh, is a good friend of mine and she is the youngest attendee of this whole NRI Conference. Priya is just 16, but she wanted to be here. We appreciate her. Of course, she is going to listen to a lot of jargon here and politely put up with it. So, I want to thank both her and my wife in advance for your courtesies and indulgence in this and you recognize that I am doing all of this; I am collecting brownie points for future. So, when I go back, when I am working, I have a bit of reserve that I am building up. In my case it will get used up in a day or two.

As I mentioned earlier, Dr Deepa Vollapalli – you may come forward – is, I would say, the

researcher, a scholar, etc. She has been involved also in security environment based in Washington DC with the US Institute of Peace and she also spends part of her time with the India Centre at the University of Pennsylvania etc. Later on, she may have some comments to share with us.

With that, I would like to introduce Mr Mohanty. He heads the Hindustan Aeronautics Limited with many of their operations and some of you are probably familiar with the Light Combat Aircraft that has gone through a series of tests etc. Earlier, it was pointed out that these are large complex projects and one of the themes that is also coming across this morning is that a lot of the initiatives that we are talking about on R&D etc. is not dealing with rocket science per se, pun intended here, Gen Mohan Das, but it is management issue; it is a vision, leadership issue, integration and you may call these soft scales; but they are very very crucial, sort of force multipliers to make anything happen. It is no different in industry either. I will make one other comment. It is quite often I see here that knowledge is one mile wide and quarter of an inch deep. What we want to encourage more and more people is to get an awful lot of knowledge that is deep in one area and become damn good at it and unless we are world class, and our previous speaker talked about that, that if you are going to export and so on and so forth, you need the systems that are going to assure the end-customer the quality, the delivery, dependability, ongoing support services, etc. So, this is the business backbone, so to speak, which is very, very crucial and this is something I am certainly picking up at today's session. As I go along, I wanted to tie up a few of these things together. Now, Mr Mohanty is to speak. The next speaker will be Mr Jayant Prasad.

Address by Mr N R Mohanty, Chairman, Hindustan Aeronautics Limited

Good morning, ladies and gentlemen.

Probably, most of you must have come to India with a preconceived idea that the public sector undertakings in India are not functioning. After listening to me, if you can change your concept, I will be grateful. That is my first objective. The second objective is – can you help HAL for its growth and by that process can you help this country which is the country of your origin for the rapid pace of its growth.

Let me now come to HAL. HAL was established in the year 1940 by a private industrialist by the name Seth Walchand Hirachand. The then British Government, in the year 1945, took over this private industry and took it under its control with the intention that during the Second World War, the aircraft which were all used can be overhauled by this industry and this company was kept under the Ministry of Industry. Post-Independence, our Government took it over and put it under the Ministry of Defence with the sole objective that this industry can work to provide the military aviation requirements in the field of defence.

Over the last six decades, this company has grown significantly. We have established excellent infrastructure; we have got highly-skilled manpower, competent managers and designers who are running this organization. Our products are – the combat aircraft, the transport aircraft, and various types of helicopters. Also, we make the structures for the satellites and launch vehicles. I can claim that this is one of the unique aviation industries. I say unique because if we see the world over, you will find that there are aircraft industries who make the airframe and the aircraft in turn, but they buy the aero engines from another company. They buy the avionics, they buy the aggregates from other companies.

But, in HAL, we not only produce the aircraft, we make the aero engines, we make the avionics and we make different aggregates for various systems like hydraulics,

mechanical and electrical. While saying so, I will say that in the last few years, what type of aircraft we are producing. We have produced various types of MiG-21s, MiG-27s, Jaguars. We also overhaul Mirage and also produce, as I said, various types of aero engines. Now, when I am saying this, you will be wondering that all these aircraft that I mentioned to you are designed and developed by others. We are producing these aircraft under licence.

What we wanted to do today is – can we not design our own aircraft, design our own helicopters so that we can not only meet our own requirements, probably we can get into the export market. So, our thrust today is on research and development, in-house research and development. Ladies and gentlemen, I would like to share with you. When I am talking about research and development, it needs money. We, in our company, have taken a decision that 2 per cent of my turnover or 20 per cent of my profit will be earmarked every year as the R&D reserve. You will be happy to note that I have got today about 1,000 highly-qualified engineers who are engaged in this research and development.

Dr Aatre has mentioned earlier about the Light Combat Aircraft. The Aeronauticals Development Agency and HAL together have designed and are producing this aircraft today. We have produced two technology demonstrators. It is flying and hopefully, very soon, in probably another three-four years' time, it will get into the Indian Air Force.

Last year, we produced the Advanced Light Helicopter. I must claim that it is one of our products for which all of us boast of. This is a multi-role, multi-mission helicopter. This has been inducted into our Indian Air Force, Indian Army, Navy and Coast Guard. The civil variant is under certification. I am sure, in another couple of months, this helicopter will be certified by our DGCA – Director General of Civil Aviation – and will be inducted into the civil market. This is a 14-seater helicopter. It can operate in minus 40 to plus 50 degrees centigrade. This has already been tried in the desert environment, in the Siachen, about 6 kilometres top in the Himalayan Range and successfully it has been tried out. It is not only our customers, as I said, but Army, Navy, Air Force and Coast Guard are happy about this product. The entire world is looking at this helicopter. Ladies and gentlemen, I would like to share with you - quite a few companies like Israel Aviation Industry and BI Systems want to join me to market this helicopter in the world market.

Our thrust, as I said, is on exports. You will be happy to note that today I am working with the Airbus, Boeing, Mitsubishi Heavy Industries and we are exporting quite a few things to them. I will now sum up. I have talked about this company very briefly. It is up to you to decide whether the company is doing well or not. My financial turnover last year was Rs.2,700 crore with a profit of about Rs. 350 crore and we have given a dividend of Rs. 69 crore to the Government which is our only shareholder and it is about 57 per cent of the share capital. It is up to you to decide whether the public sector is functioning or not functioning.

The second objective of mine is what I expect you to do for this organization. I want technology. As a matter of fact, the other day I had gone to Israel to buy some technology for the manufacture of the blades which is required for the aero engines – both for civil and military. Ladies and gentlemen, I would like to share with you, they said that they cannot give us the technology because their main partner was Pratt & Whitney of USA who have told them not to give this technology to India. This company has gone to China, built up one joint venture company there in China. Rolls Royce has joined them. They have a joint venture company with Rolls Royce. But they do not want to come to India. Can you help me? Can you help me in giving me the technology?

The second area where I want your help is – can you do the marketing of my products? Can you buy ALH for yourself, can you buy ALH for the country in which you are staying?

Thank you, ladies and gentlemen.

Observations

Thanks, Mr Mohanty. I have calculated and that means Rs.54 crore is now available for R&D based on his turnover of Rs.2,700 crore. That can go a long way if that thing is applied properly. The issue, of course, of technology denial is something that, I think, the extent of it may change, but it will never go away. Every country in the world looks after its own interests because they say there is no such thing as permanent friends and that is okay. US denies a lot of things even to its closest ally, Great Britain. They fight with each other, they do this, they do that. They deny a lot of things to Israel. The reason I say this is that it is a fact that that happens. It does not mean we are being rejected. But the way to change it is by getting stronger, by having enough chips in your hand to trade. Then, the other guy deals with you. When there is something in it for each other, that relationship builds. If it is strictly a buy-sell or a licensing process like you talked about, then it is a one-way process. But when we have created things of our own, and especially I would say right now, in the homeland security side of things, US is desperate because they want to move fast. There is a huge amount of things to be done. In fact, some even in a low-tech area aspect of it where India can play a good role because the more these relationships build, if you make the bridge wider and longer, more cars can pass through it. That is always the issue. So, will technology denial ever permanently go away – I do not think so. I do not think even the youngest audience person here, Priya Sharma, even in her lifetime, I do not think it will go away. So, that tells you about the rest of us who will fit into that timescale. But if it is given, it is okay. It does not mean rejection.

I will also say to you that the Israeli model of R&D in the defence area has worked tremendously well. They have taken the initiative; they even captured the Russian technology in the 1967 War; they improved on it and now they sell people the retrofits for the mix etc. So, the name of the game is to innovate, innovate everyday and innovation means risk-taking and it means failure. I have seen among all my friends in the Indian industry and I imagine that is even worse, in a sense, in the Government because their systems are so messed up. The risk-taking does not exist. In the Government you have to deal with the dreaded Financial Adviser who wants to know why you need a hundred rupees to buy a pen or whatever it is and he will spend eight hundred rupees trying to make you justify that; or, of course, our Vigilance Commissioner and the Comptroller General of Audit etc.

Whenever I get opportunities to discuss with the likes of Mr Advani and all, I have been working on him and others to get the culture changed so that critical resources of time do not get wasted on useless things because there is that feeling that if that guy really chokes all the details that somehow he is going to save the country money; but it has taken seventeen years to get the AJT approved. Thank Goodness that sometimes the NME is just as incompetent as we are, but that has really nothing to feel good about taking 17 years to get a project approved.

Address by Mr Jayant Prasad, Joint Secretary (Americas), Ministry of External Affairs

Thank you. Thank you, Sharad, and congratulations on having put together this most stimulating, brainstorming event. You spoke just now of technology control and technology control regimes and the fact that they would not go away and before starting

off I thought I will tell you that this intersection that we find today of weapons of mass destruction and international terrorism has ensured that we are also pretty much in the technology control game now. Also given the level of technological development in India, this is a *sine qua non* for us to acquire even higher levels of technology.

In a sense, this session provides a glimpse of a transforming India and also of the new dynamism that is defining India's overseas partnerships. Developing technologies in India related to defence and internal security is a nascent area of partnership for us driven by common needs and interests of democracies facing similar threats. The long-term strategic perspectives of countries facing the threat of international terrorism are tending to converge. It is in response to this that we are in the process of radically altering the parameters of our external engagement, both in defence and counter terrorism.

Technology and knowledge-based cooperation will be the driving force for such engagement. Already, in our external economic exchanges while merchandised trade has been steadily increasing, knowledge-intensive trade in services is going much faster at a slowed down pace of between 20 to 25 per cent per year, compared to the 30 per cent and above growth that we saw in the last five years. Technology development and R&D in defence and counter terrorism, whether it is for high-end defence military platforms or weapon systems or intermediate level detection surveillance monitoring or interdiction devices will require dexterous handling and a higher degree of cooperation than we have seen so far between concerned governance and industry representatives. And this is even more so of India.

Also, since production and trade and end-products and technologies will have national security implications and since these straggle the area of export licensing and export control issues that govern defence and dual use technology transfer, we will have to evolve a new framework for such cooperation as a prerequisite to exploit more fully the opening opportunities that we see today.

Sharad's suggestion in his written synopsis on setting up a practical mechanism for interaction with the Ministry of Defence, for instance, is an excellent one. Next time when we consider a similar subject or hold the discussion on it, we could have an even more practical setting involving the participation also of the end-users, representatives of defence forces and those involved in combating terrorism such as representatives of a multi-agency centre of the Ministry of Home Affairs. We also need to think of innovative ways to build mutual stakes between Indian and foreign partner, defence and internal security related supplies. This will do many things. First of all, this will remove the reticence in diversifying our own sources of supply of sensitive technologies and systems. It will also provide future partner of ours, external partners, assurance on non-diversion of the production and supply as also a base for global sourcing. This is something that many of the preceding speakers have spoken about the problem that we have in transferring development to production because of the low demand of such products in India.

Technology transfer is, in fact, an issue that increasingly dominates India's relations with developed countries, especially relations with the United States with which I am directly concerned. When Mr Kenneth Jester was here in November at the end of last year, in his address to the Indian industry he made a startling revelation that tells you a little bit about the kind of mindset that exists on both sides in India and the United States, among Indian importers or sources and US vendors about the constraints that exist between India and the developed countries in this regard.

He said that some 300 licence applications involving export of half a billion dollars in aggregate in the financial year 2002 were returned without action to the vendors because they simply did not require any export licensing from the United States. So, there is a presumption amongst those who are willing to cooperate with India or

willing to export goods to India that there are constraints when actually these constraints no longer figure. This is the reason why during Jester's visit we decided to set up a high technology cooperation group to work towards a new framework for hi-tech trade reflective of our new relationship and of our common strategic interests. This body will hopefully do a lot of things, but principally three or four are: free a large section of controlled goods and technologies from licensing requirements; introduce presumption of approval in the broadest categories of goods and also for reasons of control and provide a system of assurance and verification that stimulates trade in sensitive goods.

We require also to undertake a major exercise in public education on both sides in India and the United States to assure Indian and foreign partners generally that areas hitherto concerned no-go areas are now open for business. This will generally make dual purpose trade in goods and technologies smoother and inspire confidence amongst US and Indian partners that they would have an environment of long-term stability in the relationship. And this assurance will be a prerequisite for any meaningful relationship in this area. Also, since the multilateral technology control regimes or technology denial regimes, in effect, whether they relate to nuclear, missile, chemical, feedstocks and precursors or even general ammunition issues like the NSG the Australia group, MPCR the Vasanar arrangements and the corresponding national laws in various developed countries. In a sense, all of these take their cue from the United States and so we hope that progress of our initiative which necessarily will be slow because it is a difficult area. This should help in achieving the objective we have all set for ourselves today.

Thank you very much.

Address by Dr Anupam Srivastava, Executive Director, "India Initiative" and Centre for International Trade & Security, University of Georgia, USA

Thank you. It is a unique privilege to address a gathering which, I might say, with a staggering area of expertise that is assembled here. And yes, Jayant's excellent presentation was a perfect thing to what I have to say. One of the challenges as well as opportunities of coming so late in a presentation is that half of what I had to say has been covered. So, I am going to do two things. I will begin by telling you a quick story by a colleague of mine who used to teach at Harvard and he is now back in Israel. He was once asked by the State Department to give them a quick survey of the Middle Eastern situation and he asked – how much time I have. And they said – you have got half-an-hour. And he said – I cannot do it in 30 minutes. So, they said – just give it to us in a word. And he said – well, in that case, the situation is good. So, they said – No, that does not make any sense; we give you two words. He said – not good. That shows to you the complexity of the subject that we are dealing.

So, what I am going to do is, sort of, use my slides as a backdrop. I am not going to refer to them thematically as I go along, but I will move the slides forward. What I will do is I will present six points to you which flow from one from the other that are, sort of, distilled impression that I have of the sets of issues that need to be looked at as we develop a strategy and a spectrum of technologies on which this kind of potential R&D co-development is possible.

You will see that I have just listed some of the areas of interest that have been identified in some of the recent bilateral US-India meetings. I flagged these only for future discussion and as Sharadji rightly pointed out this is the start of a process and not really an end in itself. The first point that I had to make was about defence autarchy. An essential point that I want to make is that in the 1980s as I was involved in analyzing and understanding some of what the US Department of Defence did was

that it moved from a strategy of producing across the spectrum and achieving defence autarchy into becoming a niche producer of critical technologies and then encouraging US defence industry to pick up the slack and provide the rest of the things. And by the mid-1990s what happened was that the US DoD stopped being both a majority producer as well as a majority procurer or purchaser of these technologies and the ability of the US DoD to buy state-of-the-art equipment from the US defence industry partly became a function of the financial solvency of the US defence enterprise and, therefore, the DoD, over the last few years, has transitioned itself, as I said, to be a niche producer as well as a facilitator and enabler to the US defence industry.

What that means for us in India is that the Indian defence industry and the DRDO have some lessons to learn from and apply to becoming a niche producer as well as an enabler to the Indian defence industry. My second point that flows from there and something which I think is really the theme of this Conference is for us to establish a spectrum of technologies on which co-development would be the appropriate way to go rather than to do it all alone and in this respect again people have mentioned very rightly that the technology embargo regimes have created an opportunity in India which, I think, has been picked up by the Government to create, to harden itself from these further technology controls and, therefore, the indigenous platform or technology has gone up.

I think the need now is to create an environment and a mechanism for technology-embedded capital to come to India in the defence sector so that we can produce a set of technologies which will give us a fungible pool of technologies that can be adapted and configured to different defence requirements both in this country and for the end-users in other countries that we have in mind.

My third point flowing from that is something that is very familiar to this audience and that has to do with bridge technologies. What I mean by that is the Indian defence enterprise has, for a variety of reasons, something to do with geo-politics and cold war, relied itself on the Russian system for its own technological development in some senses and that is a fair and a reasonable approach to have been taken. What I wish to point out now is that in the future, as we look to the next ten years or so, it is critical for us to identify that the Indian technological development in the defence sector does not become primarily dependent on the financial solvency of the Russian defence enterprise which takes me to my fourth point and that is if India does, in fact, diversify its technology acquisition strategy and sources, then it gets and it receives better terms of trade from both Russia as well as the other partners, in this case, I flag France and Israel and potentially the United States.

One of the other operational derivatives and advantages of doing something like that is that if the Indian defence technology base as well as the weapons platforms that we create are not predominantly Russian based, then it becomes a lot easier for us to integrate other western systems. Otherwise, systems integration does become a problem for us and in an era where you are looking at a spectrum of threats that is very, very fluid, it does become important for India to have a fungible weapons platform that can be drafted and configured to different needs.

I will raise a quick fifth point that Jayant has ably elaborated and that is for India to look at the regulations that define export controls and intangible technology transfers. These are just FYIs that I am leaving here, but my remarks are based on it. These are just a few gains that India has achieved in its own export sector and the bottomline on this point is that what the Indian Government is trying to do which, I think, is the correct thing, is to try and bridge the gap between itself and multilateral standards that it has to achieve so that the Indian regulatory framework essentially looks similar to those systems as well as perform similar functions with the level of robustness that gives to the western countries and not just the United States the level of confidence to engage in technology embedded transfers with us.

I will just go to the final point. On the US side, and this comes from a series of briefings that I had the opportunity to give to the different US agencies, network-centric warfare and the role of IT in loop-data networking is an area that they have identified as one of critical importance. The other is a spectrum of things in the area of counter terrorism where they have strong interest in working with the Indian side. So, I throw them as points of discussion for us and I thank you all for listening to me patiently.

Address by Maj Gen P Mohandas, CMD, Bharat Dynamics Limited

Thank you, Sharad. Friends, it is an honour for my company, the Bharat Dynamics Limited, to be given an opportunity to put across what we are doing, what we are looking for and what we hope to achieve. Bharat Dynamics Limited which I head, is the only manufacturer of single-shot devices in this country - missiles, anti-tank, surface to air, soon air-to-air, and surface-to-surface missiles of various ranges from two kilometres upwards to all that Dr Aatre decides to give to us. In addition, we are manufacturing torpedoes, decoys for use by the Indian Navy and we are in a big way into developing simulators, which would reduce the costs for training for operators of missile systems and similar single-shot systems.

We are, therefore, in a big way into developing simulators as also state-of-the-art test equipment for all the devices that are manufactured at Bharat Dynamics. We are in a great way into the system of absorbing technology. We work very closely with the Defence Research and Development Organization in the Integrated Guided Missile Development Programme and we have absorbed the technology to the extent that we are able to produce the missiles they have designed and developed for the Armed Forces of India.

To ensure that the time to market is reduced, we have product life cycle managements software installed and everything today in the company is on a very fast track in terms of transfer of information and transfer of technology from thought to product. As you are all aware, we are basically into manufacturing strategic products, products that have a high gestation period. So, those of you who are looking forward to partnerships with such industries in the country should be prepared for that kind of time overruns because every product that is developed and presented to the user has to be continuously modified to finally satisfy the requirements he has in his mind and as the strategic dimensions change, the requirement of the effect that the product has to achieve will keep changing and it is the responsibility of industry that is providing such product support to be continuously evolving that product.

We operate on a consortium approach. Though we are a public sector undertaking, we have a large number of collaborators from the private sector. We integrate the systems and we provide the product support to the user. Bharat Dynamics has, over the past few months, entered into memorandums of understanding with a large number of industries across the globe. So, Anupam would be glad to know that we are having MoUs with French, Italian and Israeli companies, in addition to those from Russia for products that have to be given to the Defence Forces in the country.

I must also put across to you that my experience with the company and my dealings with foreign companies have mainly come to a certain very interesting conclusion. I think military industrial companies abroad are getting cash-strapped. They are looking for support from countries like India. I have a large number of requests to collaborate with the leading missile developers across the world, to co-develop latest missile systems. We are now in the process of co-developing the second plus anti-tank missile shoulder-fight devices both surface-to-air and anti-tank. To that extent, I would like to inform this august audience that we are not as far behind as we presume we are. Naturally, such JVs would mean a win-win opportunity and I am

sure both Bharat Dynamics and the collaborators that we are going to have would gain from this exercise.

We are looking for partners to market our products. If we co-develop state-of-the-art devices, we would like to sell it abroad and there is a large market for the products that Bharat Dynamics makes. We are looking for those positive marketing partnerships and we are also looking at the Government. For those of you who are from Government here, to help us improve procedures so that the time to market is reduced. Bharat Dynamics is open to technology in their missile development and torpedo development fields and those of you who are willing to give us that technology, we are in a position to pay for it.

As far as the technology absorption capability is concerned, we are capable, I think, of absorbing the latest, state-of-the-art technology and we have the infrastructure that is required for the same, thanks to the Defence Research and Development Organization.

The red light has come on. I have not shot any missiles from here. So, Sharad should not be worried on that count.

Thank you very much.

Address by Dr Rajiv Desai, Founder, 3Di Systems, USA

Thank you very much. Thank you, Sharad. It is always humbling to come back to the places where you grew up. I went back to my school. I could not believe that things have changed so much. The thing that I am going to talk about is that the major war has changed a lot. By the way, I formerly worked with NASA and also a few years ago for Air Force through NASA and for the last five years I have my own company and I have been involved in a lot of corporation set-ups and so on, but have been intimately involved in defence research and also in science and technology in general and space research.

Yes, I did bring some props, and that will keep you interesting. But more importantly, what I wanted to talk about was – I could talk endlessly about robots and how you can use them on our borders and how all defence technology has changed and such things. But I think I also want to say several other things that I may split the talk into two parts. One is, of course, how do you defend with technology and why that is an imperative. I think there is no issue about the technology being important. The nature of war has changed and I think all of us realised that rudely last year. Whereas a large component of the war in the past has been retaliation, it is really now prevention, monitoring, prediction and containment and retaliation, of course, is there.

A lot of emphasis today is on the advanced technology development for defence. It is really on the effectiveness of weapons, but it is also on fighting and conventional threats. And conventional threats are really not something you fight back; it is something you predict, there is nothing much you can do. They live with you. Really, the approach and strategies that you take for technology development for the conventional weapons is quite different because it is really a motive of prevention and prediction and that is different because that is not how the weapon systems were built in the past. The key areas that the technologies in this area are relevant are remote sensing, image processing, data security, data mining and the Bar-X. The Bar-X happens to be one form of remote sensing. I have just mentioned it because that is something I know a little bit more about.

The issue is really information management, information collection, transmission and distribution and receiving information management and actually data mining. We

have been thrown terrabytes of data as our servicing go by and figuring out which is difficult. A lot of strategies have been developed over the years. They do not work anymore because resources of data keep getting more and more broad. The specific areas that have taken a lot of interest and remote sensing are actually implanting sensors, collecting remote sensor data use in lieu of controlled systems, autonomous for robots, micro robots, etc.

A lot of these technologies are fairly mature. They have been around for over 20 years. A broader sample of something that we have built for Air Force is there. It is for deployment. It is a little small robot. It was built with the bigger one over there. It was built with the idea that we wanted to kind of reconnaissance and dropping things in places where it is hard to send people also in the terrains. As you know, we are exposed to a wide variety of terrains as in India and it is not always possible to actually man these terrains. A number of technologies have come about; are in micro robotics or in sensing; have come from other sources such as the space and in the private sector. We displayed our whole robotics world or sensing world into two regions – one is physical agents. There are things like robots and airborne drones and submarines etc. They all use common technologies. And there are other areas what we call software agents or information agents. Information agents are not necessarily in software; they also may involve physical information. But that is the other thing like network monitoring agent, data-based agent and data-mining agents. They are increasingly taking more and more relevance, the new realities of how the information is transmitted. A lot of you are familiar with that.

Integration of all this information requires tremendous chaos and lots of experience in building systems. There are very, very desperate works of cross-culture and different bond ways. I heard that across from everybody that we are not that strong in system integration. A lot of war people that I work with often have defined specific systems and built very, very large systems. Otherwise, they get built easily by defining very specific projects. I am a very hardcore engineer. I saw many people here. We would like to build things; we would like to build very specific things and that is really how we can start at. We specifically take an objective of planning of a 10 kilogram robot on Mars or protecting 400 metres by 400 metres area or doing land-mining, detecting land mines, etc. in well-defined areas. This is really how it gets started and then what comes out of it is a solution that often has a lot more applications. This is how this was built.

One of the problems we had is – dropping sensors that get reoriented once they drop. It is very difficult to do that. Also, because of communication power and all those constraints, it was hard to build things that were small but also very effective. So, we came up with this idea of multi-nodal systems that we dropped last, all over the place and there are autonomous little robots. The difficulty was that how do you reorient these. So, somebody came with the idea – why don't you make small robots that we can drive or they can drive themselves. It looked like a bad idea initially – how do we do that because there is a programme going on in MIT. We actually pulled out something from there. As we built this whole system, it looked like an ant. There are things like an ant and what we do is we drop them, naturally in an egg-like shell. A lot of them are lost upon dropping which is part of the design. I hope it is 40 per cent or so. Of this 40 per cent, they essentially create a network. Once they drop they do exactly what an ant would do. They break eggs, they open their legs, they break their eggs and they come out, they reorient themselves and start walking. There are sensors inside them and they reorient themselves to whatever the need to develop. They have tentacles. They look like animals because they are animals. So, it is a very specific technology. I am not recommending that this is what we use for anything.

What happened is that we are solving very specific problems. We wanted to get a coverage of multiple squares of Mars, the full coverage for a specific sensor. This was

integrated with airborne systems. The idea is that you really need to pick on very specific problems, create new notions and new solutions that actually address those problems. You would be amazed how many other places of technology we used after that or at least for some types of applications where it is very difficult to deploy wheel-based vehicles. This is very simple. They reorient themselves to the way they need to be reoriented and then they communicate and when they die, they die and that is the thing and it is out of the network.

My point is – all of us are familiar with the story of this culture of a bird's eye on Arjuna. A lot of projects are undertaken in the US through this or other forms and are really done with a very specific objective in mind. The objectives are defined by the military, but the research is done there. Even R&D projects have a very, very defined objective. They usually lead to productions within a short phase and various agencies and technologies are brought to bear. I am not going any further.

What I am saying is that you need to identify the specific areas. Then, there is a lot of scope for cooperation. All of us will get together and actually bring to bear what we know. With an objective of identification of such things, it is usually very difficult to talk about.

Thank you.

Address by **Lt Gen Malik** (Retd)

Thank you, Mr Chairman. Ladies and gentlemen, I bring to you the user perspective of the 39 years of service. I just retired two years back as Chief of Staff, Western Army. Let me start with a couplet as a kind of inspiration. Sharad, there is no offence meant to you. I used this in an article that I wrote last year. I also do some writing.

"Soldiers and the God
are remembered in the time of trouble
and never before.
Once the troubles are righted
the soldiers are forgotten and the Gods slighted."

It does not matter. When you are talking of the technology, there is something. Some technology gets developed only for the sake of technology, for the romance of technology and we have many examples of it. Also, there is a tendency that some technology gets developed and I am not bearing any State secrets in that, for the money that comes in because the Defence has got tremendous amount of money. In fact, when the Tehelka took place here I was very upset with my son who happens to be in the UK He has sent me a tape of Pentagon War. It is the story of the Bradley armed personnel carrier developed there and if you see it, it will put Tehelka to shame many times over. We are not competing.

But when you put the user in the loop, there is a tremendous advantage and you have got a lot of success stories. The first I would like to say is the early eighties because user knows it because he is the one who suffers. We have the never-type system which was developed by HAL as Mr Mohanty will bear me out. This is an Indian Air Force and the HAL success story. We had this in the Navy and the Russian sensors were available to us because of the control regime and the erstwhile Eastern Bloc gave us the weapons. They were both integrated and for our Navy we were able to have a very good set of ships. This was done by VISO and that was in Metcalfe House of the DRDO. Our own Indian Army and you will know Gen Mohan Das and others, we had Plan AREN, Army Radio Engineering Network in very close collaboration with BEL and later the Army

strategic communication network. As I heard just now from my friend Mr Anupam Srivastava, he said two points. One, he said about what should happen and that technology capital should come to India.

I had the privilege of representing FICCI in the deliberations with the Commerce Ministry for formulation of the policy. That happened in the year 2001. A lot of meetings took place. CII and ASSOCHAM were there; FICCI was there; the Ministry of Defence was there. Because this particular problem is being addressed and after a lot of deliberations, there were a lot of meetings and the policy came out last year, that is, in 2002 on the 4th of January. I got the notes here in case someone is interested as to what is the Government's policy. In this policy, the guidelines for licensing production of arms and ammunition issued by the Government of India, Ministry of Commerce and Industry, Department of Industrial Policy and Promotion, SIA, ST Division.

As far as the Indian Army is concerned, I know slightly more in detail. But the same is happening in the Navy and the Air Force. We have taken on board the revolution in military affairs and that is what mostly we all have been talking; of the kind that you saw in the Gulf War and compare then with what happened in Kargil. Kargil is in our collective psyche. Most of us, thanks to the electronics media, know it, it was brought to the drawing room and for the first time people were able to see what the Armed Forces are going through. Compare that, four years later, with what happened in Afghanistan and what is still happening. Within these four years, you see the Indian Army fighting and you see the other armed forces fighting and you will find the gap that exists and that will tell you the distance that we have got to cover.

As far as the blood and guts are concerned, they will be here in our subcontinent for a long time to come. But the best Army in the world needs the best IT and both are there in India. It can happen if we take the initiative. In fact, I gave that in my presentation and I need to amend it – not India, I said both are with Indians because that includes the diaspora.

There is another point that I want to mention about the technology. A lot of comments are made for the user side. Yes, there is a mistake, because as for the user coming on the cutting edge, he is always worried as to what the other guy can bring against him. In fact, Anupam was just reminding me about Gen Musharraf. Both of us happened to have done a course in the UK for a year. He, of course, will never admit that the Indian Army is the better Army. But he was always worried and it came out in discussions. After all, one year is a long time to hide things. He was worried of the scientific know-how, the technological base our country has and our industrial capacity. That is something that did scare him quite a lot and it came out in discussions. So, that is something that we have got to build on and close this gap – what you are seeing in Afghanistan war or the operations and what happened in Kargil.

Coming back to the point of qualitative general staff requirement, we often are told that you give very unrealistic kind of a requirement. Yes, that is because as the thing is getting developed, a new technology has come on the horizon which the other guy is going to use it against you. So, my point from the user side is that legitimate changes must be taken on board, lest the product becomes obsolete immediately after delivery or immediately thereafter something else is brought from the other side as a counter.

The other point is about the distances between the point when the prototype is getting developed and thereafter when it is being put in the production series and the user starts using it. As far as this point is concerned, I think there is a requirement to educate the customer. Thank you very much. The red light is not on yet.

Thank you.

Address by Dr Alok Chaturvedi, Purdue University, USA

Yes, we are going to blitz you with slides and our demos. Thank you very much for giving us the opportunity to speak to you. We are talking about measures to response and this is a simulation which we did last April with a number of government agencies starting from local Fire Chief and Police Chief right up to the White House and the Department of Defence and the Centre for Disease Control. This is a simulation for MBC type of environment.

Here, everything is based on what we call a synthetic theatre of war and all this got started in 1992 when I was invited to a synthetic theatre of war in Washington DC and I was fascinated when they fought a synthetic battle which got distributed all over the globe and they had live, virtual and constructive entities and they were fighting theatre level of war with few a hundred people. So, we have a similar set-up in our synthetic environment where we have collection of goods and markets and economies.

Here, our basic tenet is that we create two parallel worlds. You have a real world there; the data is actually collected and most of our previous speakers have talked about that. It is all about information management, it is all about data mining. So, we mine the data and we create a synthetic world so that the operators and the decision-makers and the Commanding Generals can make the decision in this virtual world, try, learn and make mistakes in the virtual world before actually trying it out in the real world. So, what we have done is – we have developed an artificial agent-based synthetic environment and which is at the bottom of that where if you see artificial agent-based engine and something which Rajv talked about where you have all these ends. We have artificial people and we model the behaviour of these people and we create a very large synthetic environment. So, we can create a synthetic city, a synthetic state and a synthetic country.

In this particular example, what we have is we are creating an artificial environment where if there is a chemical attack or biochemical attack then how that disease is going to spare and Dr Shailendra is going to give some demos. The idea is – here we have a very complex model that how the disease is going to spread in population and this is based on some standard model. So, what we did was we created people; in our synthetic environment we used 2,50,000 artificial agents to represent citizens of United States and if there is a bio attack how this disease is going to spread and we looked at some different things – basic needs, public mood and mitigations. So, we had two groups of people – one were the responders and the second one was the elected officials. They had conflicting objectives and it came out loud and clear and you will see that in the demo. So, we had three groups of teams – Federal, State and Local and at each level we had homeland security, human and health services and the Department of Transportation and they moved around making decision on a hand-held device and on the back-end we were running on a distributed terra-scale computing levels. So, we had 900 processors linked together and we were running 250 artificial agents and we were clocking at 1.4 terraflops.

Address by Dr Shailendra Mehta, Director, The Krannert E- School Entrepreneurship Initiative

A great German film-maker was once asked what was the secret of his success. He died very young at the age of 28 and made landmark films. He said the secret was very simple – there are 5,000 mistakes that any film-maker makes and I learnt to make them very early on. So, that really is, basically the idea which populates this simulation that if you are basically going to respond to a bio-terror attack and as I mentioned there are nine teams of responders who are interacting in the simulation; there are all sorts of mistakes that they can make. The kinds of decisions that they have to make on which those mistakes can be made are – shutting down roads, shutting down airports,

quarantining people, vaccinating individuals, allocating hospitals, essentially generally managing the chaos that would ensue. The point is that you intervene too early. You basically risk, cry wolf to offer. The situation might not even have developed before you respond. On the other hand, if you intervene too late, you might basically have thousands of dead bodies. So, essentially it was a tension between this measure of response if you like which was the subject of simulation.

The interesting thing as Alokji has pointed out earlier is that the same simulation basically gives you views at different levels and different classes of entities. Basically, I can respond at those levels. So, there was the city view which was basically manned by the local Police Chiefs and Fire Chiefs and the Mayor; the State view manned by the Indiana Office of Homeland Security and then there was the Federal view which was managed by the person who was incharge of incidence command.

We go to city view first. This is the view of Downtown Indianapolis. The circle of infection that you see spreading is around Indianapolis-500. Basically, we were not allowed to ultimately use that town because it is too close to the actual event. We actually used fictitious music festival, but the idea was that there are seven individuals who come in pre-infected into the United States with the specific objective of infecting other individuals. So, that scenario is set into motion; a dead body is found and then the first responders have to decide what to do – identify the disease, identify what needs to be done and then decide whether or not to close off roads, airports, etc. So, all of this is faithfully recaptured here. The road structure, the airports, the movement, the position, infectibility and the well-being of the individuals – all of that is captured and that is basically seen as this simulation evolves.

The next view that you see is the State-level view because obviously as people move from city to different parts of the State, the infection is carried and you can see basically, the infection spreading to the North-East corner of the State there. And then finally, as people move from the State to other States, basically the infection is carried to the North-East and the South and so on and so forth. So, all of this is done in real-time, essentially when human beings interact with the artificial agents in this environment. We also have a short video clip that you can see of basically the individuals in action.

This was the setting. This is basically an intimate setting, not very different from the setting that we have here. This is how it looked like. This was the room before the simulation actually took place. These were basically our research assistants. And then, you will see in a moment the three separate groups of teams – the local, State and national teams – where it is being set up now. There were several high resolutions in this place. This is basically the place. The person that you see in the jacket there is basically the Director of Indiana's Homeland Security Office. He and several others – the person here is the professor of psychology at Indiana University. So, they were basically playing, if you like, the Indiana role or the State-level role. The person that you see in the foreground there is Gen Kain who was the head of the Y2K Centre in the White House in the Clinton Administration. The folks here basically are the people who are playing at the national level.

So, in this environment you can get a good sense of how the simulation evolves. All this is in real time. We play a period, typically a day in about 15 minutes. So, you can go through several periods in a couple of hours. And then we can have a focussed discussion about where coordination basically broke down and what we can do to basically fix it. I will close now.

This is just one application. We have used this for supply chain management for simulating the telecommunications industry for recruitment, for all sorts of applications where you can create a synthetic environment and rather than making your mistakes in the real world you make them in the synthetic environment and you can basically project into the future and done from it. So, we believe that there are many sorts of applications and we will be happy to talk to you about this.

Questitons & Answers

Mr M Sharad Marathe

This is for Mr Mohanty. The question is – HAL takes pride in manufacturing all systems and components of its aircraft. How do you reconcile that with the other strategic objective of sharing expertise in specific domains and not a one-mile wide and a quarter of an inch deep?' The questioner was Mr Vardhaman Bawri in Cleveland of Ohio. I suppose he picked up on my one-mile wide and quarter of an inch deep thing.

Mr N R Mohanty

Your question is – can HAL share the things that they are making vis-à-vis of strategic importance. Sir, there is no difficulty absolutely in giving our products or the technology to whoever is interested, provided he is not going to fight with us. That is the crux of the issue because we cannot share our product or the technology with anybody who is going to fight with us. But anybody who is friendly, who wants to capture this is welcome. For example, I was talking about Advance Light Helicopter. It is available to anybody. As a matter of fact, some of the countries are showing the interest whether we can jointly develop this product in their country. I am ready for it.

Mr Sharad M Marathe

Mr Mohanty, I think the question was, if I understood it correctly, it is saying – since you are into a lot of different things, how do you avoid the syndrome of one-mile wide and quarter of an inch deep. It is sort of saying – can you be all things to all people and keep them all happy.

Mr N R Mohanty

Yes, we can do that. There is no difficulty about that. That is what I wanted to say.

Mr Sharad M Marathe

Perhaps, the message that may have gotten lost is - his is a very large organization; Rs. 2,700 crore is an awful lot of money with many different sites and so on and so forth. So, that probably may give a wrong impression, but frankly I would think HAL included that every organization, however small also, can benefit from more focus rather than less. So, I am sure, he would be receptive to that part of it.

The other question came from someone in the Ministry of Defence and I could understand that why that person really did not want to write the name down. There is no problem. It is – border management in India poses a lot of problem. The borders include glacial area, mountains, deserts on the one hand and jungles, marshy terrain, etc. on the other. This leads to incursions move across a porous border.

Delegate

The borders are well-known. We are sharing our borders on our western side, northern

and eastern sides. There is a lot of cross-border movement on these borders and it is very difficult to man the borders with the present equipment and manpower. Even the very vast coastal area is there. So, what sort of technological equipment etc. we can have which will help us to manage the borders? One cannot write that down.

Mr Sharad M Marathe

Thank you. I am sorry, that is the difficult part of it to read. Can any of the panellists raise their hand and offer any hope for me for the first round? If not, we got the first volunteer from the Co-Chair. Go for it, Santy.

Mr K Santhanam

I think the most recent and fairly comprehensive report that has been partially declassified and in the open domain is the report of the Group of Ministers after Kargil and Kargil Committee report submitted by Mr K Subrahmanyam. That is number one. Secondly, it is not that India alone but even the US has problems with Mexico in terms of porous border. It is not unique. It depends upon how much time you want to spend on solving it and whether you want to be serious about it. Thirdly, there is no one magic wand or silver bullet that can solve the problems all over. We need a variety of sensors. From 1989 onwards, some of us have had the experience in the desert and in Jammu & Kashmir and not yet Bangladesh, which had not become much of a problem then. There are a variety of things and there are unique field problems which may not be understood by persons outside India. Your cables are cut by desert rats. How does it work? So, you have to have raticide or whatever is the word – anti-rat cables.

Having said that, a variety of means including unmanned aerial vehicles and superior intelligence collection systems are needed. Having got the intelligence to reach it to the field commander in time, that is the internal systemic problem and not a technology problem. So, it is as much management of the borders as it is a technology-driven.

Thank you.

Mr Sharad M Marathe

I think, maybe, Dr Aatre can add some light to that.

Dr V K Aatre

Clearly, it is a very challenging task. We are looking at it. Regarding the coastal thing, though we have about 7,500 kilometres of coastline, it is not necessary that every inch of the coastline has to be monitored. There are clearly choke-point areas; there are certain areas which go towards the islands which are identified; we are looking at the short range thing. There is a coastal surveillance system which is trying to be put at place. As far as the sea is concerned, the sensors technology system, technology exists in India. As far as the land border is concerned, as Mr Santhanam was pointing out, we have tried out a few; we have not succeeded. There are dialogues with some companies in US also looking at border surveillance. There is a technical report given by some of the scientific organizations as to how look at the border.

Delegate

The Indian Army had evaluated the US Army's Rembast system Remote area battle assessment system. At one point in time, it fitted a variety of sensors. It was not found to be adequately efficient and error-free for Indian conditions.

Mr Sharad M Marathe

There is one off-the-cuff comment from an ignorant guy because you guys are experts in it. But I would say if you use things such as GIS and 3-D mapping among other things, at least you will get a better terrain definition and some image analysis software maybe, the ISRO collects a lot of pictures, some better techniques of that type. It just becomes one more set of tools in your bag of tricks. As I think, both the answerers mentioned, there is no silver bullet, so to speak, and I do not think anybody ever will find it.

Mr Sheelkant Sharma

I just wanted to say that no amount of science and technology can change the mindset. A lion does not need to defend its den. You have to choose also at some point in life – which side you want to belong; on the side of the sheep or the lion; because this border management is isotropic; the risk to you and the other side is the same. Thank you.

Mr Sharad M Marathe

Dr Sheelkant Sharma is with the Ministry of External Affairs and, among other things, he has got an interesting area, I think, to look after in which the US relationship matters a lot. They are interested in the so-called technology denial issues that came up earlier. One of their fears is how India makes sure that the technology does not seek out of here into other unfriendly places or other places that we do not want it to go to. So, he has got a sort of a challenge that deals with all of you who have technology or other Indian industry etc. and then he is the guy without any weapons on his hand to shoot anybody that does not do it right. But he makes commitments on behalf of the country.

Delegate

One-liner. I personally do not like the phrase technology - denial regimes. It is more in the nature of export control regulations. Thank you.

Mr Sharad M Marathe

The next question is - "A lot of talk on terrorists using sea route to smuggle weapons of mass destruction into the country. Can the robot technology be used for such detection?" I guess the obvious choice is our robotics expert, Rajiv. Do you want to take it?

Dr Rajiv Desai

It still falls under the realm of border management, not equipment. One of the three points that Mr Santhanam mentioned as very critical, is also a big part of this, that

is, container scanning. That is a priority for everybody there. There is also a lot of robotics used in what is known as surf zones or identifying the other things. There are solutions, but there are no pinpoint solutions, that is, no one answer to this. Even the main borders are actually not uniform; there is a lot of variety. So, there are no pinpoint solutions, but there are general solutions.

Mr Sharad M Marathe

So, you got robots that swim?

Dr Rajiv Desai

Oh, yes. Especially on submarines etc. It is robot tuna.

Mr Sharad M Marathe

So, he has got the ants, the fish and the whole works.

Dr Rajiv Desai

For everything, there is an animal form, a robot.

Mr Sharad M Marathe

It is interesting.

Dr Alok Chaturvedi

I would just like to add a few more things on that, having been in discussions with the US Coast Guard and other places. This was also being mentioned by one of the Co-Chairs. You cannot replace the human intelligence part of it, because even if whatever technology you are using, you are using it on your land whereas if you can get the intelligence where the ships were and who are the crew and what are their containers and where the containers have been, that is going to go much further than any of the other technology which you are using on land.

Mr Sharad M Marathe

As you know, quite often, I think this is a game of probability because there is no 100 per cent of anything. So, in each case you are improving your arts. So, every little bit of thing you can use towards that purpose is finally that comes out of the bag of tricks. Anyone else wanted to add to that?

The next question is, and this is from Mr Durgesh Mankikar – "Have you presented your material to the American Medical Association or to the American Society of Anaesthiologists or emergency physicians? They are all interested in this topic." And this was aimed at Dr Shailendra and Dr Alok.

Dr Shailendra Mehta

Actually, I have started working with a set of people, mainly through centres for disease control and through some of the constituted companies which have a deep level of expertise in this area. Very much so, and also through the community of epidemiologists. So, there is obviously a very large research community in that area centred around universities and the research laboratories and we are interfacing directly with them and through them with medical doctors and others.

Mr Sharad M Marathe

Again, this thing here, the issue does not always begin and end with technologies and borders and all. The internal security aspect does get into the medical side of it as well.

Delegate

I think you also have consulted epidemiologists.

Dr Shailendra Mehta

Absolutely. We are working with epidemiologists; we are working with human and health services, so right up to Washington down to the local doctors – we worked with, everyone is involved in that.

Mr Sharad M Marathe

Because the rules of the game have changed from well-defined enemies it is a mess. The next question relates to investment in R&D; would there be defence-related bonds, what would be the return on investment on stocks; would there be an official list of all defence-related companies where we could invest, where would you get such a list, are companies like 3Di in private or public. I tell you – in the interest of time I am going to defer this till the end. It is a valid question because this is finally the survival and the growth of these companies depends upon their return on investment and what value they deliver. But I think, it slightly gets away from the focus. But I will hit that a little later.

Mr Sharad M Marathe

The next question is – how does India place itself while selling their defence technology to the Arab world, while India is closely associated with Israel on defence collaboration. Again, this is one of those questions that we may want to refer to MEA or others. If somebody wants to volunteer an answer right now; I am not sure it belongs to the R&D thing.

Dr V K Aatre

Anyway, a very quick comment. Right now we are not really selling much of defence technology. We have started participating in the defence exhibitions like Mr Mohanty was saying, if somebody wants to buy LCA we will be more than overjoyed. The demarcation between selling to Arab and Israel and others has changed from time to time and this is a matter which we do not want to discuss in public. We will not sell

equipment as Mr Mohanty pointed out, to people who, we believe, will use the equipment against us or against our friendly countries.

Delegate

I may add a couple of things. There are "defensive" or less-sensitive items needed by some Armed Forces in West Asia. These were items like batteries that are being developed in India and they have been sold in the past. That is one. Secondly, West Asia, anyway, is the marketing hunting place of USA and European firms. So, we will be late-comers and, therefore, not likely to have much of the thing. Thirdly, India certainly, none of the sensitive technologies, is developed whether they are related to missiles or nuclear or whatever; we will never be exporters. We have tight controls with respect to such exports. I may add that at one time Col Gaddafi wanted two nuclear bombs from India at the height of the oil crisis and the Government of India did not respond. Thank you.

Mr Sharad M Marathe

In this kind of a thing, India has a fairly good track record; in every country, I think there are military secret leakages, unfortunately. Each system tries to make it better and better.

The next question is, Santy, it is for you again: "The nuclear command is in place; now what next? Where do we go now for further nuclear advancement?" The second part of the question is – "Are we planning to develop ICBMs; if not, do we have not a need to do so?"

Dr V K Aatre

I will answer that question. The question of developing ICBMs and others is not raised. What we wanted to demonstrate in Agni-I and Agni-II is that we are capable of developing missiles of various ranges. Some of us scientists do believe that between a 3,500 kilometre and a 5,000 or 14,000 kilometre range missile it is not that much of change in technology as the will to do it. If we decide to do it, we have the technology to do it. The Nuclear Command was just to be announced. The details have been worked out. Obviously, for reasons which I do not want to disclose, we are not going to disclose exactly what we have done. Whatever is released in the Press is in the Press which the Prime Minister has answered.

Delegate

It stands for itself.

Delegate

I think the early stages of the American ICBM programme and they have failures, that ICBM was called into Cuba by mistake.

Mr Sharad M Marathe

One question is aimed at Anupam and Jayant. "Do we know from experience that US non-proliferation laws are often modified to suit the changing US national security and foreign policy needs? Is the current positive trend of US-India dialogue on techno-

cooperation also based on changing US needs? What is your assessment about the depth of US interest in technology cooperation with India, given the techno-control regimes?

Mr Jayant Prasad

I wanted to remind this audience what the Raksha Mantri said in November, 2000 and that very much holds today. If because of our capacity to develop a neo-synchronous orbit satellite we do have the necessary wherewithal to develop ICBM. So, the Raksha Mantri said that we have no such intention and that very much holds. I want to add also that we are a country of scarce resources. Certainly you can add in an extra thing; and ICBMs, if they have to be used, could be used against such countries. We do not anticipate that we have such a deterrence requirement.

So far as the technology control regimes are concerned, it is absolutely true that the assumption of the question is correct. These are applied in consonance with the perception of national security and as it is quite evident, the Indo-US relations have changed. So far, they have changed in terms of atmospheric thing which is important; we now deal with each other directly and in a non-elliptical manner. Our conversations are very frank, forthright. Where we have differences we try to understand each other's position; try to narrow those differences wherever possible. Where we have a consonance of interests, that is the determination on both sides to work together. If this trend were to continue, then very soon we would have the nuts and bolts of it in place. So, at this juncture, I do not think I have to say anything more than what I have said.

Thank you.

Mr Anupam Srivastava

A couple of points. The first is that the United States, as Jayant rightly said, does use export controls and trade policy as a strategic tool of political statecraft and, therefore, some of its behaviour and interpretation of laws does stem from its own fluid and continuous reassessment of needs on national security and so on. Some of that is used, sometimes, in trying open certain markets to secure competitive terms of trade for its own businesses. But the other thing is that the US export control is generally pegged towards a multilateral standard to which other countries are also encouraged to adhere themselves and I am happy to tell you that I saw Dr V Sidhartha here and several others, Dr Santhanam included; several people who are from the Indian Government who worked hard in the last several years to bridge the gap between India and these multilateral standards, both in the functions it performs as well as in the appearance of that system. So, the institutions not only perform similar function but even essentially look similar to those standards.

The final point that I will make here or two points actually quickly; one is that within the US agencies there are schools of thought; there are NASAs and there are promoters of closer US-India collaboration and what we need to do, therefore, is to work on a few systems faithfully which, in turn, will strengthen the hands of the pro-India lobby and that itself will try and hopefully build upon that and you add a more incremental process of collaboration.

The final point is – the three Ps that the US Government uses – P for policy, process and procedure – and in US-India dialogue as Jayant and some others might bear me on that, there is a distinction. When you have a mid-level career diplomat and a lower level diplomat. When they come to India or when Indian agencies go there, they are

only authorized to discuss process and procedure level things and sometimes there is an expectation by the US and the Indian side that the gains from process and procedure level can be translated in to gains at the policy level which it should be. Unfortunately, what happens is the expectations at the policy level are sometimes different for the two sides and sometimes it is premature to bring some of the gains and the process and procedure quickly up to the policy level.

So, what I am saying, to simplify, is that some of these bounded areas of cooperation need to go forward and then translate that overtime into gains at the policy level to build the sort of larger relationship that Jayant talked about and about which I feel the atmospheric happenings etc. were there in the last few years.

Thank you.

Mr Sharad M Marathe

There is this kind of a broader issue here and that of confidence-building, winning the trust and once you have a trust you can go to a higher trajectory if you will in a relationship and scale. One of the things we are hoping somewhere down the road is to create a sort of, a virtual institute that needs to be funded etc., that will pull some money together and have US organizations the well-established foundations and all that will do research, create policy options from the viewpoint of what is in it for US, India, etc. and properly publicise that. Because when you get that kind of mouthpiece talking about relevant issues, then the US Congress and other people and the media also take note of it.

India is very poorly represented in the US media. This kind of a research does not get done. Even if we had the know how and had done that research, that does not carry credibility because we would be thought of as being biased. That is a given thing. You are not going to change that. But those kinds of initiatives have to be taken for long-term benefit for it. But on these things we cannot be looking at a one-year time horizon. Even in this R&D kind of a contact one point I was going to make is we would like to seek about an 18-month or two-year kind of a time window and another one that is a five-year window that looks down the road a little bit. It is because we need to invest for the future. Anupam, you had some other comment.

Mr Anupam Srivastava

Yes, a quick point for sixty seconds. This is not to plug myself. But Dr Seema Gehlot is with me, NRI, helped for several years, about eight or nine years ago to create a programme on South Asia within the University of Georgia for the Centre for International Trade in security which over the last several years has become a repository working on the intersection of a science technology, trade and security and we advise over 20 governments about the Soviet Republic and China to India. Our programme on South Asia has now grown to a university level. I am happy to tell you that I directed that programme for the University of Georgia, all the India initiative which is the largest formal commitment made by a US university to better US-India relationship.

Our centre has an extensive data bank and expertise built on export controls that we used to train officials, for example, in the Russian Parliament on the US export control or the international export control system. We are trying to build a similar data bank on India and Pakistan. In our experience with the Congressional staff versus the people, the last point that Sharadji was making, what we found is that the Congressional staff

were generally 18 to 25 years old people. They are given about a day's notice to scour in the Banking Committee or any other place. There is an oath to be taken and these Congressmen write to their staffers saying – tomorrow get me a speech ready and these guys do not know where to get information from.

So, we started doing a series of briefings to them as well as providing our information on our database freely available to them, so that that becomes the first place that they go to, to quickly get this kind of technical information. We believe that if it informs and improves their quality of what to feed to their Congressmen then it subsequently improves the quality of discussion within the Sub-Committee and the Committee on the floor and then on the floor of the Congress and that is how we are trying to insert more balanced and technical clarity to the US authorities.

Mr Sharad M Marathe

In this sort of technology export control sides, all the legislating gets done in the US Congress and the US Executive body, the part of the Government. Having a good, keen understanding of it is very critical because the guy sitting across the table from you on a given technology that Gen Mohan Das may want or may not have the authority to do so. That comes from a legislation. So, these things have a longer gestation period and understanding that becomes very, very crucial.

The next question is – "I am a management consultant professor from the United Kingdom." I should have done this earlier and I apologize. So, let us do two things. All the people that asked the questions so far, would you just kindly stand for a moment – not just this question but the previous questions? I want this audience to know that they took to do it. Now, when I read this question the person that asked that will stay standing. The question is – "My question is – the entire session this morning discussed the need for technology. Does this also use management technology to ensure cost-effective R&D done on a time-based process and products? What are the Indian public sector enterprises present here doing in this area? Are they competitive?" I presume, implicit in it might be a slight sales pitch. But that is okay. Let the answerers tackle the question. Since the question was raised to the public sector, Gen Mohan Das, do you want to tackle that?

Maj Gen P Mohandas

We do utilize management technology. Today, the public sector is competing with the private sector for tendering to the Armed Forces. In fact, most of my products which are of slightly lower technology are also being manufactured in the private sector like decoys, mines and we compete with the private sector. So, our costing systems are utilizing the necessary inputs that are available from the management institutes. We hope we are processing them right because we are getting the orders. I think the proof of the pudding is in the eating. I am able to under-quote. Being a public sector with my social responsibilities, we have responsibilities as you all are aware. We have to contribute a certain kind of money into a certain kind of social activity. In spite of that I am able to gain orders from the Armed Forces who are obtaining quotes from the private sector, who are operating with a very limited staff, with very limited responsibility. So, to that extent, I think we are utilizing the right kind of approaches for bidding, for costing, for cutting costs. On a continuing basis, we are trying to improve productivity. We are trying to cut costs accordingly because the moment productivity improves costs come down. We also understand that if we cut costs we will get more orders, because the Armed Forces can get more value for the rupee spent. We understand all that and we are doing it.

Mr K G Ramachandran

I agree with what Maj Gen Mohandas said. In addition, taking it away from the defence field, because in the defence field BHEL has been one of the non-defence PSUs engaged. But we have an interesting R&D set-up not in the defence, of course, but more of it is in the power sector which happens to be our core area of operation. There, we have done tremendously well in trying to improve technology as far as combustion of crude oil is concerned. I must say that all this has been done very competitively. So, our costs are indeed right. We have had a success rate awesome success rate of 89 percent in international competitive bids that we have participated in right from 1978 onwards up to the year 2002. So, I do believe that we have the qualities or systems right, being able to deliver competitive products and systems.

Delegate

For the information of those of you from outside, there are eight public sector undertakings which are totally defence-oriented. I was in the Ordnance Factories. These eight public sector undertakings have formed a consortium called the Society for Defence Technologists. We share the technology; we have centres of excellence created so that we can cut down costs and we operate in a very collaborative fashion. There was a point which was raised earlier in one of the presentations that we must collaborate, we must share technology. It is a continuing basis and those of you who are interested in approaching defence public sector undertakings, in fact the Society for Defence Technologists, based in HAL, it is the right place to get to because it will tell you which is the defence public sector undertaking which is the centre of excellence for that kind of technology.

Mr Sharad M Marathe

The person who put the question may please stand. The question is – "Given the fact that US is very cautious about transfer of technology, can there be a meaningful defence cooperation between US and India?" I suppose in a way this was answered earlier. Do you feel so? To the extent it is missing, Jayant, do you want to add anything to it?

Mr Jayant Prasad

I think a point to be added here is that while there is a problem from the US side, there is a problem from the Indian side also which has not been articulated enough. And that problem is the absence of assurance of long-term supply. Both the US concern and the Indian concern are not only related to long-term assurance of supply, but long-term technological cooperation between the two countries. It is answered if we take from Anupam the cue of core production and building on synergy that we have and to start up with, we do not need for a major change of policy because there is a change of application of existing regulations from India. There are no longer any sanctions applied against India. I think this is not very well understood and this is the point Dexter was making when he came and spoke to us and said that 500 million dollars worth of supplies to India were held up for an average period of 43 days in the United States getting entangled in infructuous licensing procedures which were not required.

So, while we are pushing for a change of policy which should only come about slowly, as a factor of improved Indo-US relations, there is already a dispensation by which we can begin to collaborate in a number of areas which were foreclosed earlier. If we begin with the few good examples, then that would build synergy for perfect things.

Mr Anupam Srivastava

Both he and I again worked with a team that prepared the groundwork for it. I can once again reiterate what Jayant rightly said that there is a lot of expectation on the other side and what we need to do now is to identify these bounded areas, work for them without getting very passionate about them and without thinking about very wide fluctuations in our cooperation. It will just build on those habits of cooperation and translate them into good things.

Mr K Santhanam

I think at the suggestion of the US Administration the mission area cooperation in the light combat aircraft was begun in 1985 and thereafter Pentagon gave a briefing to you as aeronautics industry, all the majors as to what is releasable within the guidelines of the F-16 A and B level of technologies. There are other mission areas of cooperation that are possible, because once you get into the mission area of cooperation then you do not have to go item by item sanction or approval of licences. On the other hand, there may not be such identified areas where the US Government and the Indian Government want to work together and that they get into the case-by-case processing.

Dr V K Aatre

Even within the case by case processing, there is a whole variety of what are called distribution licence arrangements which go through automatically without much of hassle in the seven by seven period of processing. I would like to mention that the agreed minutes signed between Secretary Perry and MOS Mr Mallikarjun on January 1, 1995 clearly says that we have to have more such project-oriented or technology-oriented programmes between the two Governments. The related point that is of relevance now for this audience is to register and take back for whatever work they want to do is that there is more than a warming up, there is a very vibrant service to service cooperation. Then, there is the joint technology group that has been talking and hopefully acting pretty soon. So, the ambience is very different from, shall I say, the sanction-obsessed feeling that sometimes I see in the media.

Thank you.

Mr Sharad M Marathe

Thanks. The next question is – "Does the Defence Ministry look into environmental critical technologies and the impact of other technologies on civilization when conducting Army drills? This relates directly to human security at large." Will the person that asked this question, Ms Swati Rao – stand up? Dr Aatre, do you want to take that?

Dr V K Aatre

Absolutely yes. For example, when we established our missile testing range, that is the area where Oliver turtles were hatching. So, we had taken certain precautions such that we do not interfere with the eco-system there. For example, when we did develop and maintain core desert areas surrounding Siachin and other areas, we take care. So, there is no conflict with environment and defence.

Delegate

The next question is from Mr EMDHSS Punia. "During World War II, several fundamentally new technologies such as radar got developed in a short time. How can we compress time element on a war footing in our R&D?"

Dr V K Aatre

You must realise that science is a peace-time endeavour and technology is a war-time endeavour. You cannot keep the same velocity or the development that happened during 1945 and let us say in radiation level like today. In India, the R&D velocity is low because of the reasons which we have discussed. The base was low, the industrial infrastructure was inadequate and the material component device technology did not exist. So, if we go for a war or if there is a control of regime, which is a blessing in disguise, we used it as a challenge, certainly the development will be faster. When there is no control regime, when there is no war, the general tendency is a little more relaxed. This is by nature. I do not think it will change too much.

This comment of everything taking its own time is a slightly exaggerated thing. If one looks at the major platform development like tanks or aircraft, we started from a technological base which did not exist. If you look at some of the other things like electronic warfare systems and radars, our development cycle is good. If you are going to look at the delays in programmes as comes out in the Press, you are only looking at half of the information being wrong. I do not think the development cycle, other than the two or three major projects, there have been such a long delay.

Mr Sharad M Marathe

I think that when there is a surprise that has occurred, then what occurs on a far war-footing is procurement from outside, like in the way of Kargil. I would also like to say that apart from major complex systems like the tanks or the aircraft, there have been many others where in a partnership mode involving the user very strongly, there was a gap involving the development agency and production agency, items have been delivered within two years which is like a war-footing. The only thing is that we do not talk much about it, because the other stories of MBT, Arjun and LCA are more sexy for the media.

Dr V K Aatre

You must also realize, we are looking at, as somebody pointed out, we are fighting a war against an enemy who has access to a probably much later technologies than we have. So, our equipments also have to be so-called state-of-the-art technologies. Technology maturity from the inception takes ten to fifteen years and most of the systems do not mature for twenty years. Even if you take 15 to 20 years in developing an aircraft, the aircraft remains current for about 35 years. In fact, lots of people have been saying that LCA is so long delayed it will directly go to a museum. I have defended it every way saying that then the museum has to be built in 2045. So, technology maturity takes more than a decade or decade and a half which is not unusual. I have worked in defence, outside India. The cycle of technology development for major platforms in India is no more than the time taken indeed for other platforms elsewhere. We are well aware of how long the F-16 and others took. We are well aware of how much JAWS has taken and Eurofight has taken. Unfortunately, in our exuberance we quoted figures which we cannot meet. That is all I wanted to say.

Mr Sharad M Marathe

Right. Happiness is a function of expectation. In fact, I have seen a lot of US defence companies. You talk about bureaucracy. They invented it – incredibly slow in many cases.

Dr V K Aatre

The only thing is we perfected it.

Mr Sharad M Marathe

Yes. But I am hoping that our R&D thrust will improve and the time to market will find the way to compress. I think we are just about out of time. I am going to run through these questions very fast. "Is the GOI Defence establishment thinking of appointing agents for promoting their products?" Mr Chockalingam from Australia asked that question. I think Gen Mohan Das had already answered that question. The answer is yes. Each of the presentations goes back and forth. The human future is about fighting and winning wars; even a third world war could be possible.

The question is – "Has Gandhi relevance to India and the world? The Rajiv Gandhi Government still held to the dictum of non-violent nuclear force world. Has it any relevance in India's future?" Frankly, I am going to rule this question out. I understand the question. It does not fit the theme.

Mr Sharad M Marathe

I am just going to read the question, get it answered. Anybody wants to comment. It is later, but I am not going to let this run over much at all. No offence to any human being per se. "Can DRDO take a lead on this quickly?" The time is running out.

Dr V K Aatre

As I have understood, there is no dictum from DRDO that the latest technology cannot be imported. In some cases, it is facilitated. But DRDO's responsibility is generating indigenous technology. If there is a new technology available, both of our industrial partners elsewhere are already welcome; give it to them. I cannot be an intermediary to absorb technology and give it to them. That is not my job.

Mr Sharad M Marathe

His mission is to develop.

Dr V K Aatre

Yes, the mission is to develop. We have the technology. You give it to them.

Delegate

We are importing the latest technology wherever it suits us. Naturally, we are not going to import technology which is not required.

Mr Sharad M Marathe

I am going to move on. This is from Mr R N Mehra from Iran. "India and diaspora are forging constructive relationship. To work this, Mr Chairman, there should be a forum to help in expediting and resulting in a healthy cooperation; as without commitment, timeframe and accountability we cannot reach this." As we talked, I agree. Our hope is to come up with a series of recommendations, report to the Government, come up with some clearing house mechanism. But let us not get too psyched up about this. These things take time. What we are looking for is a starting process. We could not predict a given outcome.

We are going to come back to the question that I promised to come back to. It is on investment in R&D and such other return on investment issues. Are there investment opportunities? Gen Malik, do you want to offer a comment on that?

Lt Gen Malik (Retd)

The Press Note No. 2 of 2002 series from the Government of India, Ministry of Commerce and Industry, has been issued last year on 1st January, 2002. Just very quick points – licence applications may be considered and licence given by the Department of Industrial Policy and Promotion, Ministry of Commerce and Industry. I think it is not Ministry of Defence. They will, of course, consult the Ministry of Defence. But it is to the Industrial Policy and Promotion Department of the Ministry of Commerce and Industry.

The second point is – there will be no minimum capitalization for the FDI. The third and the last one is that the Ministry of Defence is not in a position to give purchase guarantee. This is the point that was alluded to earlier. But there is a three-year lock-in period. The document is here.

Just one quick point if I may – when you talk of the technology, let us not forget our environment in India. Romance is okay; if you go on towards too much of a technology, the hills and the mountains will not change; our adversary will not change; so, you may come to a point that a critical mass which is required of the Armed Forces that may not be there; black boxes cannot win war. Thank you.

Mr Sharad M Marathe

May I run very fast through two remaining questions? "Would there be an official list of all defence-related companies where we could invest?" Dr Aatre says they could make that list available.

Dr V K Aatre

We can make that list available.

Delegate

The list is available, but I do not know it is open for investment.

Dr V K Aatre

Right now, there is no restriction. There is already, as I said, the FDI is clearly known. The list will be given. DGQA has the list. We will ask it to put it on the web.

Mr Sharad M Marathe

Whoever has the questions, talk to these folks later. "Our companies like 3Di are private or public?" He is private.

What I would like to ask is my other three Co-Chairs – if you would take abut 30 seconds each, if you have some sort of reflections and then at the end Mr Ramachandran has a role to thank you and I have one little before that.

Dr V K Aatre

We have had a good session, whatever that may be. We have exchanged views. As I pointed out, in India all meetings end well and till the next meeting we do not talk to each other. The doors are open. As the Prime Minister and the Deputy Prime Minister have indicated, defence industries are open, defence laboratories are open. Please contact us. We would like your assistance. We would like your help and, as I have pointed out, as equals; and join us to make India stronger. It will be great.

Delegate

I believe, after having watched the things between India and US for 17 years or so, in the area of technologies for countering or finishing terrorism, that is an enormous new date and set up new opportunities available and I think meetings like this, communities like this can help at best to mutual benefit. Thank you.

Mr Sharad M Marathe

I have a couple of very quick concluding comments. The First of which is to compliment this audience for being here, asking very good questions and I was told during the break as many of you came by and they really liked the fact that this was well organized, went through together and all. That organization means that the audience participated exceptionally well to which all of us, the panel, thank you. Let us give you a big hand. Mr Ramachandran will have the concluding remarks. But the panellists prepared well. We appreciate that. There is a lot of work that lies ahead. We intend to do it. You use the web site to communicate with us, with ideas and also individually you can e-mail and so on and so forth. We do intend to present a report to the Government, but not let it sit on the shelf. I am a pest; if I believe in something I go after it and I will try to rope in others as well. But it is a collective effort. What I hope to do through this process is to get various people to pledge to move forward on it. We will have some other off-line discussions. I am sure they will have more detailed kind of one-and-one thing in which we do not necessarily need to announce. It is not relevant. But on my personal behalf I do want to thank you for your indulgence. You have helped a lot. We hope this is an ongoing relationship.

With that, I turn it over to Mr Ramachandran.

Mr K G Ramachandran

Thanks. All things including all good things will have to come to an end. So, this particular session on a subject which is very difficult, which has serious challenges has also come to an end and I would like to join Mr Marathe in thanking everyone involved, including those of you who have come and participated in today's discussions for resulting in good decisions as such. I would say that good things do end, the end objective must be remembered. I represent industry and I believe that – no, we will see

it only when we see the an results, end results; bottom, line so to say. I am sure, I think, this will not just be an event but it will become a sort of a movement. Here, I think, we would take further action that is necessary and in that action I would again want to offer one thing. The FICCI Defence Committee would play a crucial role. We want to play a crucial role. I, as the Chairman, want to see that it plays a crucial role.

Thank you once again for being here and having patiently participated in making this a very good session.

Thank you all.