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## Workers

We were at a meeting laying down the targets for 1984, when news came of Dr Brahm Prakash's death on the evening of 3 January at Bombay. It was a great emotional loss for me, for I had had the privilege of working under him during the most challenging period of my career. His compassion and humility were exemplary. His healing touch on the day of the failed SLV-E1 flight surfaced in my memory serving to deepen my sorrow.

If Prof. Sarabhai was the creator of VSSC, Dr Brahm Prakash was the executor. He had nurtured the institution when it most needed nourishment. Dr Brahm Prakash played a very important role in shaping my leadership skills. In fact my association with him was a turning point in my life. His humility mellowed me and helped me discard my aggressive approach. His humility did not consist merely in being modest about his talents or virtues, but in respecting the dignity of all those who worked under him and in recognizing the fact that no one is infallible, not even the leader. He was an intellectual giant with a frail constitution; he had a childlike innocence and I always considered him a saint among scientists.

During this period of renaissance at DRDL, an altitude control system and an on-board computer developed by P Banerjee, KV Ramana Sai and their team was almost ready. The success of this effort was

very vital for any indigenous missile development programme. All the same, we had to have a missile to test this important system.

After many brainstorming sessions, we decided to improvise a Devil missile to test the system. A Devil missile was dis-assembled, many modifications made, extensive subsystem testing was done and the missile checkout system was reconfigured. After installing a make-shift launcher, the modified and extended range Devil missile was fired on 26 June 1984 to flight test the first indigenous Strap-down Inertial Guidance system. The system met all the requirements. This was the first and very significant step in the history of Indian missile development, which had so far been restricted to reverse engineering, towards designing our own systems. A long-denied opportunity was at last utilized by missile scientists at DRDL. The message was loud and clear. We could do it!

It did not take long for the message to reach Delhi. Prime Minister Indira Gandhi expressed her desire to personally apprise herself of the progress of the IGMDP. The entire organization was filled with an aura of excitement. On 19 July 1984, Shrimati Gandhi visited DRDL.

Prime Minister Indira Gandhi was a person with a tremendous sense of pride—in herself, in her work and in her country. I deemed it an honour to receive her at DRDL as she had instilled some of her own pride into my otherwise modest frame of mind. She was immensely conscious that she was the leader of eight hundred million people. Every step, every gesture, every movement of her hands was optimised. The esteem in which she held our work in the field of guided missiles boosted our morale immensely.

During the one hour that she spent at DRDL, she covered wide-ranging aspects of the IGMDP, from flight system plans to multiple development laboratories. In the end, she addressed the 2000-strong DRDL community. She asked for the schedules of the flight system that we were working on. “When are you going to flight test Prithvi?” Shrimati Gandhi asked. I said, “June 1987.” She immediately responded, “Let me know what is needed to accelerate the flight schedule.” She wanted scientific and technological results fast. “Your fast pace of work is the hope of the entire nation,” she said. She also told me that the emphasis of the IGMDP should be not only on schedule but also on the pursuance

of excellence. “No matter what you achieve, you should never be completely satisfied and should always be searching for ways to prove yourself,” she added. Within a month, she demonstrated her interest and support by sending the newly appointed Defence Minister, SB Chavan, to review our projects. Shrimati Gandhi’s follow-up approach was not only impressive, it was effective too. Today, everyone associated with aerospace research in our country knows that excellence is synonymous with the IGMDP.

We had our home-grown, but effective, management techniques. One such technique was concerned with follow-up of project activities. It basically consisted of analysing the technical as well as procedural applicability of a possible solution, testing it with the work centres, discussing it with the general body of associates and implementing it after enlisting everybody’s support. A large number of original ideas sprung up from the grass root level of participating work centres. If you were to ask me to indicate the single most important managerial tactic in this successful programme, I would point to the pro-active follow-up. Through follow-up on the work done at different laboratories on design, planning, supporting services, and by the inspection agencies and academic institutions, rapid progress has been achieved in the most harmonious manner. In fact, the work code in the Guided Missile Programme Office was: if you need to write a letter to a work centre, send a fax; if you need to send a telex or fax, telephone; and if the need arises for telephonic discussions, visit the place personally.

The power of this approach came to light when Dr Arunachalam conducted a comprehensive status review of IGMDP on 27 September 1984. Experts from DRDO Laboratories, ISRO, academic institutions, and production agencies gathered to critically review the progress made and problems faced in the first year of implementation. Major decisions like the creation of facilities at Imarat Kancha and the establishment of a test facility were crystallized during the review. The future infrastructure at the Imarat Kancha was given the name of Research Centre Imarat (RCI), retaining the original identity of the place.

It was a pleasure to find an old acquaintance, TN Seshan, on the review board. Between SLV-3 and now, we had developed a mutual

affection. However, this time as the Defence Secretary, Seshan's queries about the schedules and viability of financial propositions presented were much more pointed. Seshan is a person who enjoys verbally bringing adversaries to their knees. Using his sharp-edged humour, Seshan would make his opponents look ridiculous. Although he is prone to be loud and can turn argumentative on occasions, in the end he would always ensure maximization of all available resources towards a solution that was within implementation. At a personal level, Seshan is a very kind-hearted and considerate person. My team was particularly pleased to answer his questions about the advanced technology employed in the IGMMP. I still remember his uncanny curiosity about the indigenous development of carbon-carbon composites. And to let you into a small secret—Seshan is perhaps the only person in the world who enjoys calling me by my full name which contains 31 letters and five words—Avul Pakir Jainulabdeen Abdul Kalam.

The missile programme had been pursued concurrently and had partners in design, development and production from 12 academic institutions and 30 laboratories from DRDO, the Council of Scientific and Industrial Research (CSIR), ISRO and industry. In fact, more than 50 professors and 100 research scholars worked on missile-related problems in the laboratories of their respective institutes. The quality of work achieved through this partnership in that one year had given me tremendous confidence that any development task could be undertaken within the country so long as we have our focussed schedules. Four months before this review, I think it was during April–June 1984, six of us in the missile programme visited academic campuses and enlisted promising young graduates. We presented an outline of the missile programme before the professors and the aspiring students, about 350 of them, and requested them to participate. I informed the reviewers that we were expecting around 300 young engineers to join our laboratories.

Roddam Narasimha, then Director of the National Aeronautical Laboratory, used the occasion of this review to put up a strong case for technology initiative. He cited the experiences of the green revolution, which had demonstrated beyond doubt that if the goals were clear, there

was enough talent available in the country to tackle major technological challenges.

When India carried out its first nuclear explosion for peaceful purposes, we declared ourselves the sixth country in the world to explode a nuclear device. When we launched SLV-3 we were the fifth country to achieve satellite launch capability. When were we going to be the first or second country in the world to achieve a technological feat?

I listened carefully to the review members as they aired their opinions and doubts, and I learned from their collective wisdom. It was indeed a great education for me. Ironically, all through school, we were taught to read, write and speak, but never to listen, and the situation remains much the same today. Traditionally, Indian scientists have been very good speakers, but have inadequately developed listening skills. We made a resolution to be attentive listeners. Are engineering structures not built on the foundation of functional utility? Does technical know-how not form its bricks? And, are these bricks not put together with the mortar of constructive criticism? The foundation had been laid, the bricks baked, and now the mortar to cement our act together was being mixed.

We were working on the action plan that had emerged from the earlier month's review, when the news of Shrimati Gandhi's assassination broke. This was followed by the news of widespread violence and riots. A curfew had been imposed in Hyderabad city. We rolled up the PERT charts and a city map was spread out over the table to organize transport and safe passage for all employees. In less than an hour, the laboratory wore a deserted look. I was left sitting alone in my office. The circumstances of Shrimati Gandhi's death were very ominous. The memories of her visit barely three months ago further deepened my pain. Why should great people meet with such horrific ends? I recollected my father telling someone in a similar context: "Good and bad people live together under the sun as the black thread and the white are woven together in a cloth. When either one of the black or white thread breaks, the weaver shall look into the whole cloth, and he shall examine the loom also." When I drove out of the laboratory there was not a single soul on the road. I kept thinking about the loom of the broken thread.

Shrimati Gandhi's death was a tremendous loss to the scientific community. She had given impetus to scientific research in the country. But India is a very resilient nation. It gradually absorbed the shock of Shrimati Gandhi's assassination, although at the cost of thousands of lives and a colossal loss of property. Her son, Rajiv Gandhi, took over as the new Prime Minister of India. He went to the polls and obtained a mandate from the people to carry forward the policies of Mrs. Gandhi, the Integrated Guided Missile Development Programme being a part of them.

By the summer of 1985, all the groundwork had been completed for building the Missile Technology Research Centre at Imarat Kancha. Prime Minister Rajiv Gandhi laid the foundation stone of the Research Centre Imarat (RCI) on 3 August 1985. He appeared very pleased with the progress made. There was a child-like curiosity in him which was very engaging. The grit and determination displayed by his mother when she visited us a year ago was also present in him, although with a small difference. Madam Gandhi was a taskmaster, whereas Prime Minister Rajiv Gandhi used his charisma to achieve his ends. He told the DRDL family that he realised the hardships faced by Indian scientists and expressed his gratitude towards those who preferred to stay back and work in their motherland rather than go abroad for comfortable careers. He said that nobody could concentrate on work of this type unless he was free from the trivialities of daily life, and assured us that whatever necessary would be done to make scientists' lives more comfortable.

Within a week of his visit, I left for the USA with Dr Arunachalam on an invitation from the United States Air Force. Roddam Narasimha of National Aeronautical Laboratory and KK Ganapathy of HAL accompanied us. After finishing our work at the Pentagon in Washington, we landed in San Francisco on our way to Los Angeles to visit Northrop Corporation. I utilized this opportunity to visit the Crystal Cathedral built by my favourite author, Robert Schuller. I was amazed by the sheer beauty of this all-glass, four-pointed, star-shaped structure that is more than 400 feet from one point to another. The glass roof which is 100 feet longer than a football field seemed to float in space. This Cathedral has been built at the cost of several million dollars through donations organized

by Schuller. "God can do tremendous things through the person who doesn't care about who gets the credit. The ego involvement must go," writes Schuller. "Before God trusts you with success, you have to prove yourself humble enough to handle the big prize." I prayed to God in Schuller's church to help me build a Research Centre at the Imarat Kancha—that would be my Crystal Cathedral.

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