

## **Is an Engineer's Mind Different**



**Dr. P.S. Goel**

I was born in a small village in UP and was brought up in a large family. Being the youngest, I was on call for small works like bringing a glass of water for whosoever felt thirsty. Seeing a bus for the first time at the age of eight was most exciting. The driver of the bus was the hero. Travelling to a big city by train, seeing a bulb and a ceiling fan running on electricity at the age of 10 was wonderful.

The impressions on my mind are vivid and large in number, be it mother's worship in the nearby temple, her milking a cow or seeing sister delivering a baby in cold pitch darkness with serious complications and no professional help. Ultimately, what drives you is some impressions, some incidents that occur and some advice that comes in early life. Was this the excitement of seeing the first bus at the age of 8 a cause for choosing science in the 9<sup>th</sup> standard at Sir Pratap School, Jodhpur? Was the general science lesson in the middle school the reason for opting for engineering after Higher Secondary? Or being good at mathematics drove me to opt for electrical engineering? I do not really know. Everywhere, I seemed to be following the instinct, perhaps driven by those excitements of being exposed to bus or electricity at a much later time in childhood. A child born today would see them since the time of birth, and so doesn't get excited seeing them. Perhaps a drone delivering milk at the door step will excite a child at the age of 10 in 2015.

Once admitted to college, doing engineering was more of a routine, and the mind started to look at the society. Born around the time of freedom, stories of the freedom fighters and the sacrifices of thousands of youth were other thoughts that churned the mind. Then, suddenly, a saying gave a clear direction, "living for the nation is more difficult than dying for the nation", perhaps, Swami Vivekananda guided the path.

While in the final year of engineering, towards end of the term, the Head of the Department called me and said "Go to Indian Institute of Science, Bangalore and do Masters. Do not look for a job in Rajasthan Electricity Board".

The journey to Bangalore from Jodhpur was two-and-a-half days with three changes, Coming out of north for the first time, was a challenge. Luckily post cards used to reach faster, so it was only 5 days of agony for my brother at Jodhpur. Five other college mates joined the IISc, and the 2 year stay turned out to be fun. All were applying abroad, so I also applied. Got a couple of admissions also, but, then there was an offer from ISRO. The sentiment of living for the country prevailed. I had heard about rockets, but not much about satellites, I was posted in the Satellites Systems Division.

It was a bit puzzling, what do satellites do?

The quest for solving this puzzle became an engagement of a life time. It is not just about satellites, it is all about space, the environment including vacuum and radiations, the orbital dynamics and the dynamics of the bodies, the inertial reference and sensing directions, controlling motion and working remotely. It has been wonderful to explore new challenges for every new mission. Finding ways to put space in the service of mankind (the vision of the founder of ISRO, Prof. Vikram Sarabhai) and of course giving some extra leverage to the soldiers at the borders became a purpose of life.

At engineering colleges we are taught how things (say machines) work, but as practicing engineers we have to understand how things fail. Bringing reliability to a product is nothing but to understand the failure mechanisms and generate methodologies to mitigate the failures.

How I became an engineer, a Satellite Technologist, is perhaps a question to be analysed and understood, but once you are an engineer, it is not a profession but a religion. Being an engineer at ISRO brings you into another cultural dimension, where your individual identity gets submerged in common goals, societal causes and nation at priorities. Engineering becomes a means to solve problems, and not just a profession. But if it is so, then why do we have so many problems? We produce more than 10 lakh engineers a year in our country, but hardly any Indian product is seen in the world market. All rural areas are crying for engineering solutions, but engineers do not reach there. Recently we organized a study on engineering interventions to transform the Sundarbans in West Bengal into a developed region like the Netherlands, but the study document has not been read by any decision maker. The last engineering intervention in the Sundarbans was by a British engineer in 1942 to bring sweet water through a canal. Is a distributed solar power not a solution to provide electricity access to remotely located houses? Questions are millions but we also have tens of millions of engineers. Certainly, there is a disconnect. Most of our engineers are job seekers and not creators of jobs or products.

Joining the Department of Ocean Development was with a purpose to create a new ministry, the Ministry of Earth Sciences, that will look into the problems of the Earth in a holistic way. It was a new dimension of science, but the problems once again call for engineers to find solutions. Later, on becoming a member of the National Security Advisory Board, I discovered the insecurity in which we Indians live. My stay at DRDO for the last six years in different capacities has exposed me to only one truth; most of our engineers are doing their jobs, but not solving the problems of national security.

The recent INAE initiative to organize “Engineers Conclave” is just a small step to find engineering solutions to the problems of the society, through space, atomic energy, defence technologies, technologies for earth sciences, etc.

Let us create engineers with a ‘mind of an engineer’.