A new phase of my career was to start, with many uncertainties.

As for as India was concerned I started understanding about it from the newspapers (No TV in those days 1973) and some gossips during lunch/dinner etc. One thing I could find out was that there was a lot of unrest in the country. JP movement "Sampoorna Kranti" had been spreading among students. "Navnirman Aandolan" was going one. Gujarat was ~~one~~ one of the active places. Most traffic were in jeopardy. Rail

roko' 'road stops' etc were going on. Even in my "politically active" mental framework, I somehow did not like the type of politics of JP, Lohia [et al] though they were respectable people. Their socialism was vague. Opposing Nehru, ~~to~~ ~~End~~ then [shifting to oppose] Indira Gandhi was their main aim, just as [Indian] communists had a single point agenda of being anti-USA, not really bothering about the welfare of Indians, except their training. They did not have "development agenda" (to use the currently @2015/16 popular term). I somehow felt that they did not have any idea as to how grow India; how to make it industrially strong; in the process make people of India also [earlier] more prosperous. At least the Swatantra party which was

Opposing Nehru, had an agenda, though at that time I did not have an understanding of their paradigm. The mixed economy of Nehru appeared to be closer to ~~what~~ what the Soviet Union adopted, which I thought was the better method due to my communist thoughts then.

In 1968, ~~they had~~ They had that been shaken up. But it was not to adopt the JP, Lohia or George Fernandes type socialism or Asok Mehta type. Most of them were also supporting regional chauvinism. I had crafted these economic/ political framework - type of thinking out of me and was concentrating on a concrete work which I thought, would help India & Indians speedily.

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As Goma used to say more often ~~the~~ in the later years, a ~~trip for~~ stay in USA for both us (when we were) around 25 years (of age) shaped us quite a bit to focus on our life, ~~not to~~ We were self-dependent to do our work. We did not burden others. (We did not have the feudal ideas again "menial" work.) Individually each of us were good in planning our work, within the constraints etc. She used to say "Rajan, I think all the middle class Indians have to be exposed to US life in their younger adult age (~ 25-30 years) to become better organised in life."

For me in addition, a good look at American life.

had shown me that the Indian communist / socialist depiction of USA in their literature and so-called analyses, was totally biased and bereft of facts.

Looking at, from the strong point of materialist philosophy on which Marxism stands, USA had made the present life for American people worth living without unnecessary dogmas which afflict ancient societies like India, and many other developing countries, all

After all the final goal of Marxism / communism is to make people enjoy a good life on earth. And also

the poverty of USA which existed in 1970's ~~is~~ was no where near the abject poverty of India. (Poor there were better off than middle class Indians) There was a comparative, relative poverty within USA. Of course, there were other problems of ~~the~~ social inequality of black Americans etc. But other countries, even communist ones, could not claim to have put a stop to it. India was no better.

So my mind, when I saw the chaos of the JP movement, was not in it at all. I started keeping my (political/economic/social) ~~abreast~~ abreast of the developments in India, but did not delve deep

~~into~~ into it. Yes, it may be described as a life of a middle class (bourgeois) professional life.

The uncertainties of my posting added additional pressure on me. In the meanwhile I had to get involved in the testing of ESCES ~~and~~ for the compatibility with ATS-F a spacecraft (for which I had contributed a lot). There was a special letter from EVC dated Feb-1974, appreciating my work (rare for ISRO culture then and now too! @2016)

~~#~~ As desired by YP I had submitted to him a

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~~note~~ note dated 17 December 1973 about my ~~profile~~ biodata (quite earlier) and a profile of my ~~desired~~ future roles. I had some lurking fear that PPK may steal some of my ideas as he had access to Director SAC's office and had no major specific task with him or a group then. I had outlined for YP the following:

- Leading role in Advanced Planning & Systems Engineering
- Direction of our participation in satellite building activities including "buying/selling interface" to other agencies

409(a)

To
Insert at

CONFIDENTIAL

December 13, 1973

To : Prof. Yash Pal, Director, SAC

From : Y.S. Rajan

Subject : My biodata and a Profile of my desired future roles.

I have tried to blow my trumpet loud enough for you to hear, but not yet painful to the ear drum!

As regards the future profile the major intent is in:

- Leading roles in Advanced Planning and Systems Engineering
- Direction of and participation in satellite building activities including "buying/selling interface" to other agencies in India/abroad
- Occasional fire fighting and secretarial roles.

I have slightly elaborated on these points in the text.

In this context, I request you once again, that my promotion be considered in retrospect and also with increments.

409(L)

CONFIDENTIAL

BIO-DATA

AND A PROFILE OF DESIRED FUTURE ROLES

1.0 BIO-DATA

- Uniformly first class academic career.
- First class in M.Sc. (Physics with Electronics as special subject) from the University of Bombay, June 1964.
- Research Scholar in Physical Research Laboratory, July 1964 - August 1966.
- Constructed for balloon experiments:
  - (a) Cosmic Ray payloads - Gieger telescope
  - (b) Solid State FM-FM transmission system
  - (c) Logic circuitry
  - (d) Ground reception systems for balloon data and also ground based Cosmic Ray Instrumentation.
- Developed Rocket Borne S-Band Radar Transponders during 1966-1969. This effort covered:
  - (i) Overall system design
  - (ii) Hardware design and development, and
  - (iii) Environmental proofing and testing of microwave and antenna components at 2700 - 2900 MHz.
- Successful launch of this took place in December 1969. Tracked to 200 km. Probably, the FIRST OF ITS KIND IN INDIA.
- Productionized the design at SSTC.
- Designed and made detailed Systems Planning for: (during July 1969 - July 1970)
  - (i) Paramps for Radars
  - (ii) Radar transponder required for SLV missions at C-Band and S-Band

409(c)

(iii) Tracking and telemetry complexes at SHAR for SLV and Rohini programmes

(iv) Data link systems for ISRO's SLV and Rohini programmes.

(v) Microwave and antenna construction facilities for the above.

- Deputed for the ISRO-MIT Study on INSAT at the Lincoln Laboratory.
- Made effective contributions to the INSAT Study in the areas:

  (a) Protection Ratio Calculations
  (b) Antenna design
  (c) Communications components design
  (d) Interferometer
  (e) Telemetry
  (f) Link calculations, etc.

- Posted to work with NASA/Goddard Space Flight Center (ATS Project).
- Made very effective contributions to the Project <u>from the specification stage</u> (pre-Phase D) <u>to the Testing stages</u>. The areas of work include:

  (i) Communications subsystems
  (ii) Telemetry and command subsystem
  (iii) Interferometer subsystem
  (iv) Other subsystems from an overall System Engineering view point.

  Details are available in many reports by me and also briefly in Appendix-I.

- Besides the work on ATS-F as a Project personnel - many a time represented the Project in meeting with others - also made many technical inputs for INSAT. Salient ones are:

  (a) Interpretation of WARC regulations on power flux density

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(b) Protection ratios and isolation required for INSAT-S.

(c) Multiple beam antennas for INSAT-S

(d) System definition for a classified satellite for India.

(e) Other technical inputs relating to the SITE

(f) INTELSAT-IV utilisation study.

- Generated high reliability and screening specifications for components for the ISSP satellite and also gave many technical inputs and systems engineering details for the ISSP.
- Presented the ISRO case for Apollo-Soyuz experiment.
- Attended many symposia such as:
  - (i) Thor-Delta Users Symposium
  - (ii) ICC
  - (iii) ERTS, etc.
- Worked as the ISRO Representative and took care of the ISRO Technical Liaison Unit at USA from January 1973 to October 1973. Had done very effective liaison between ISRO and NASA especially during the troubled period of FEC problems.
- Generated:
  - (i) The FIRST Overall Operations plan and schedule for the Total SITE system
  - (ii) The complete spacecraft compatibility test plan for FEC and ESCES equipment.
- Attended UN Working Group on Direct Broadcast Satellites as technical assistance to Mr. Vellodi.
- Made timely contributions to technical and managerial aspects of the ATS-F GVHRR experiment collaboration and paved way for RSMD personnel in efficiently discussing with the GSFC technical officer.

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- Made very good arrangements for the Director SAC for visiting various aerospace companies, GSFC Project Managers and JPL.
- Visited many aerospace companies/laboratories many times for Design Reviews regarding ATS-F and also for special technical visits.
  - Philco-Ford
  - Lockheed
  - Hughes
  - MIT Lincoln Laboratory
  - RCA (Princeton - Hightsnow)
  - GE Valley Forge
  - JSC, Houston
  - IBM, Huntsville
  - Fairchild
  - COMSAT etc.
- After arriving in India (in about one month period) have helped the Director SAC in certain special evaluation of certain Projects, preparation of proposals such as Radiometer payload, Satellite Fabrication Facilities etc. Also helping the SITE Management Office (SMO) personnel by debriefing on SITE systems engineering and operations; assisting the Programme Manager in independent technical evaluation, writing the roles of various operational groups, etc.

2.0 PROFILE OF DESIRED FUTURE ROLES

The goals and ambitions of a person are dynamic processes which change with the growth of the organisation and society he is in, and also his own growth and the resultant world outlook. Thus a projection over a decade, especially for a person of versatile interests, is a difficult job, which I attempt here, with my crystal-ball.

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2.1 GENERAL:

My desires, ambitions, and hopes can be broadly termed as below (sort of guiding principles or motivational factors):

- To (i) shape and (ii) contribute to the technological growth in India. This includes both planning and execution.
- To play pioneering roles in introduction of new concepts, systems, and applications, to the country.

In my life, I envisage this coming decade (I am 30 now) as a period of rapid growth and acquiring very good maturity, which is needed to occupy high policy making positions beyond. To realise this goal, this coming decade has to be a period of intense activity and productive results.

Besides such active works, in order to have the right environment of growth and maturity, I need to work for, and report to, very effective and big bosses; this gradient between us will stimulate high growth rate and provide a great maturity to my thought processes

2.2 SPECIFIC

A projection of these general desires within the framework of ISRO in about 5 to 10 years would be roughly as under:

- Leading roles in Advanced Planning and Systems engineering activities.
- Direction of, and participation in, satellite building activities including "buying/selling" interface to other agencies in India and abroad.
- Occasional fire fighting and secretarial roles.

In the following paragraphs, I attempt to briefly explain the above mentioned activities.

- Advanced Planning and Systems Engineering: These could be at the level of major Projects/Centres/ISRO Headquarters.

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By Advanced Planning is meant the system level planning of future systems of ISRO's interest by taking into consideration existing developments at various ISRO units, the country and abroad. In this sense, it precedes Systems Engineering, by which I mean, more detailed technical specifications and definition of interfaces.

Both these efforts are closely knit (more so in the Indian context), as their functions are overview and tying of various ISRO activities into one big picture. This overview helps in:

(i) avoiding unnecessary duplications (as against necessary)

(ii) utilisation of developments in non-ISRO units

(iii) finding out effective ways of managing our resources, and

(iv) identification of problem areas and new areas of action.

Also these efforts will ensure whether the detailed activities fit the total picture and goals of ISRO.

The above activities could be in the form of monitoring, detailed studies and/or laboratory experimentation; the latter would be needed more in future to conceive and plan specially Indian systems. A judicious mixture of these different facets of activities (i.e. monitoring, analyses and laboratory work) would enhance the effectiveness of such Planning and Systems Engineering Group (s). It is envisaged that this activity will go on in close liaison with other Groups/Units doing various detailed activities but this Group will be independent of them, e.g. at a Centre level it will be independent of its divisions, at a Project level independent of sub-units and at Headquarter level

409(h)

independent of Centres. To repeat again by independence, no isolation is implied.

Necessarily, Advanced Planning and Systems Engineering work requires a general understanding of all activities of interest to ISRO. But specifically my area of concentration would be in:

(i) Satellite buying/building and all related technologies

(ii) Applications like communication, remote sensing, navigation, other special needs, etc.

o Direction of, and participation in construction/buying satellites and major space borne payloads:

This is an area of technology development and management. Similar to the ISSP efforts, I envisage that in near future, ISRO would be having few collaborative/indigenous satellite building efforts; some of these could be in the form of buying and selling too: We may buy subsystems or sell subsystems to agencies like INTELSAT, or Indian agencies. Thus these building/buying/selling can be broadly categorised as:

(a) Collaborative programmes
(b) Global bids, and
(c) Special Indian needs.

These activities involve not merely satellite building but also developing an infrastructure within the country, as our goal is final indigenisation or "basic self-reliance." I would like to plan out and execute these possibilities, by having major roles. I feel confident in both Project management and developmental roles.

o Occasional fire fighting and secretarial roles: On a long term basis, I would like to have a base and leading position in the activities mentioned above

specifically; but I do not envisage it as a congealed activity pattern. I am willing to take short term "sorties" for my bosses, including some "administrative"/ secretarial roles.

December 13, 1973.

Y. Sundara Rajan

(409)

~~a~~ in India & abroad

- Occassional fire fighting and secretarial roles.

I had expanded on ~~the~~ the first two in my note

~~(For the sake of completeness I am~~ attaching here the typed note to

(X) Full note attached w/o Appendix.

The first bullet can be fully in SAC to be a Staff division for Director SAC. But there were other ~~rea~~ relatively free floating contenders like PPK, Sanjeev Deshmukh, Kiran Karnik.

The second bullet was not confined to SAC alone; it could be ISSP or a new Project which SAC may like to take up. Imbedded in the "buying/selling"..."

Insert at 410 ⊕ 410(a)

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APPENDIX-I

The following are the salient points of works/contribution of Y.S. Rajan at the ATS-F Project at GSFC:

1. Joined the Project 3 months before the signing of final contract with the Fairchild. Hence had many inputs to the negotiation and review of specifications mainly communications subsystem, telemetry and command, interferometer and systems specifications.

2. Some specific instances are addition of Multipactor specification to communication system, sidelobe specifications, isolation of VHF diplexer in launch configuration, and so on.

3. Pointed out the transient as well as failure mode in which the solar array will deliver about twice the power and hence "burn up" shunt regulator; this caused major design changes (around November 1970) to shunt regulator design and heat pipes below it.

4. Played a major role in selection of ETV frequencies within the time constraints and technical constraints.

5. Pointed out the existence of simultaneous downlink of 890 MHz "beacon" if C-Band beacon is turned on. This caused some major rethinking in tracking philosophy.

6. Review of many specification revisions in the period February 1971 to April 1971.

7. Contributed system engineering backup and communications, telemetry, interferometer expertise to GSFC, during many design reviews of the ATS-F spacecraft with the Prime and sub-contractors.

8. Reviewed many test plans:

   (i) Systems test plans
   (ii) Subsystem test plans, etc. for the ATS-F project.

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9. For a period of about 2 years had been a very effective Assistant to the Electrical Systems Manager, Mr. Trudell. In fact, used to be the Project "all-rounder", to provide technical input when some subsystems engineers were absent or out of station.

   For about a year, I was the shadow "T & C subsystem engineer." Had reviewed in detail many component test procedures, attended failure review meetings, etc.

10. Have worked closely with the Project Systems Engineer, Dr. W. Redisch, and Launch Vehicle Manager, Mr. R. Mattson to provide a system engineering look to many problems like telemetry omnilink coverage percentage, monopulse system etc.

11. Taken care of certain important management functions such as pointing out faults in Thermal number calculations, Mass properties Report, etc.

12. Have pointed out the single point failure mode between the Prime Focus Feed and Earth Coverage Horn at C-Band reception for the SITE, ETV, etc. experiments and been instrumental in providing a redundant relay.

13. Have made many answers to periodic Reliability Review Committee questions and have represented the Project in defending telemetry link, coverage etc.

14. Have provided effective technical interface between experts and the Project for investigating various multipactor problems that occurred in the ATS-F.

15. Played a major role in characterization tests of engineering model transponder (ATS-F) at the Philco-Ford. This brought out the problems of small signal compression in UHF and S-Band power amplifiers and more importantly the emitted noise in Radio Astronomy band which was later solved by an output filter.

4.10(c)

16. Contributed to the review of redesign of Prime Focus Feed form.

17. Served as a member on a Group to analyse the Monopulse design problems.

18. Calculated near field electromagnetic fields of ATS-F transmitters, required for EMIC tests and also for clearances in the Launch Pad.

19. Contributed to the evolution of all-up EMIC tests on ATS-F and configuration of Anechoic chamber.

20. For the SITE experiment provided many technical inputs periodically, such as the analysis of reduction of antenna gain etc. and produced the FIRST Overall Operations Plan, and spacecraft compatibility test plans.

21. For other Project requirements, mainly for ISSP and GVHRR, had many detailed technical discussions with GSFC persons and have sent detailed reports to India. The areas are in Reliability, GVHRR design, Grounding Philosophies, multiple antenna designs, etc.

22. Have been very effective ISRO Representative at GSFC for SITE, Apollo-Soyuz etc. The technical and managerial liaison during EEC problems have been the most challenging one. Had played an important role in the technical management of the ISRO Technical Liaison Unit including the negotiations with the ISM, HP, etc.

23. Made many popular talks at GSFC for the educators/students regarding ATS-F and SITE experiment; this is arranged by the Goddard Special Programs Office.

For brevity, I stop here.

Y.S. Rajan

Should be
With my papers
written for prof Ram Ignes

BIO-DATA OF MR Y S RAJAN

~~40~~ 410 (ed)

* DATE OF BIRTH - 10.4.1943

* MARITAL STATUS - Married with one child

* ACADEMIC QUALIFICATION & POSITIONS HELD/HOLDING -

- M.Sc., (Physics with Electronics as special subject) University of Bombay, 1964. Uniformly first class academic career.

- 1964-1966 Research Scholar - Cosmic Ray Balloon home and ground based studies.

- 1966-1968 Development Engineer of Microwave Rocket Radar Transponder.

- 1968-1969 Engineer-in-Charge productionising the Transponder.

- 1969-1970 Systems Engineer - Launch Vehicle on-board systems and ground network.

- 1970-1973 Senior Engineer and also ISRO Representative at NASA/GSFC.

- 1973- Scientist, ISRO Headquarters and Scientific Staff Officer to Chairman-ISRO.

- Research Scholar at Physical Research Laboratory, Ahmedabad 1964-1966.
  Tasks done: Development of Cosmic Ray Balloon and ground based instrumentation such as FM/FM Telemetry, Digital circuits, Geiger tube etc.

- Design & Development of Rocket Borne (French Centaure) microwave S-Band Radar Transponder and productionisation - 1966-1969.

- Systems Engineering (paper studies) and planning for Indian Launch Vehicle SLV-3 for onboard telemetry, tracking and all the related ground network at the Indian Launch Range SHAR. - 1969-1970. The hardware is being done now.

- Participant in the MIT-Lincoln Laboratory study (for Indian Space Research Organisation - ISRO) for Indian National Communication Satellite for TV & Telecommunication. Major contributions in design of communication system, telemetry, telecommand & tracking. (July 1970 - Oct 1970)

....more

Reference: Dr F W Sarles, Jr
Group 69, Code 370
Massachusetts Institute of Technology
Lincoln Laboratory
Lexington, Mass 02173
U S A

- Participant in NASA's ATS-F Project Management Team at Goddard Space Flight Center (as ISRO Representative) starting slightly before Phase-D upto the integration phases of the Satellite. Jobs were specification analysis, negotiations, monitoring of subsystems and components, test plan and procedure monitoring, project reviews etc of the spacecraft Prime Contractor and of various sub-contractors. (Have visited the Prime Contractor Fairchild Industries, IBM, Philcoford etc)

  Major thrust in all the electrical subsystems and many system engineering and operations aspects. Review and analysis of all documents generated regarding these subsystems for project decisions. Also many works relating to Satellite Instructional Television Experiment (SITE). This is one of the most productive phases of my life as the Project Management in NASA style expands personality.
  Period: October 1970 - October 1973.

  References: i) Mr Richard J H Barnes
  Director - International Planning & Programmes
  Office of the International Affairs
  National Aeronautics & Space Administration
  Washington DC 20546
  U S A

  ii) Dr W Redisch
  Chief - Communications & Navigation Divn
  Code 950
  NASA/Goddard Space Flight Center
  Greenbelt, Md 20771
  U S A

  iii) Mr E E Metzger
  Mission Operations Manager, OSO
  Code 400
  NASA/Goddard Space Flight Center
  Greenbelt, Md 20771
  U S A

  iv) Mr E J Trudell
  Manager - Tracking & Data Relay Expt (TDRS)
  Code 460
  NASA/Goddard Space Flight Center
  Greenbelt, Md 20771
  U S A

....More

ANNEXURE 3

DETAILS OF WORK ACCOMPLISHED

i) Phasing out of SITE after debriefing.

ii) ISSP component purchase mission to USA - saved prototype schedules.

iii) Assisted Chairman in various Reviews of ISSP.

iv) ISRO-AIR study group on SITE continuity.

v) Handled DPVLR related activities - purchase, training and hospitality to dignitaries.

vi) Generated many internal documents of technical analyses for technical decisions, policy etc.

vii) Member of study group for feasibility study of second satellite and contributed in design.

viii) During the visit to Europe and USSR, had many useful discussions related to Advanced Planning for satellites.

ix) Due to above developed contact could manage to get an ESOC receiver for ISSP mission - to avoid delays in Ground System of ISSP

x) Have given many useful managerial and technical inputs to Project Director-ISSP.

xi) Have finished various tasks given by Scientific Secretary regarding Science Programme - convening meeting of scientists etc.

* * * *

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ANNEXURE 4

BRIEF ABOUT MYSELF AND THE ORGANIZATION, WITH REFERENCE TO MY SATISFACTION WITH THE JOB, MY CONTRIBUTION TO THE ORGANIZATION, INTERACTION WITH COLLEAGUES ANDSUPERIORS AND SUGGESTIONS TO MAKE THE SYSTEM WORK MORE EFFICIENTLY.

ABOUT MYSELF:

Generally very busy and working very hard. This gives general satisfaction. Also ARYABHATA work gives me pride in ISRO, Chairman, ISSP team and myself. However, I feel due to institutional problems my contribution is only a fraction of what I can give to the organisation. General problems are people at Centres are not good at information exchange. Within HQ technical supporting staff for me is lacking to further my analyses and ideas. Comparison of what I feel can be done in my contribution to organisation and what is being achieved sometimes leads to frustration.

One of the important features of my job in ISRO is that I have been an effective "all rounder" technically or in "personality equations". Have handled many jobs in Science, Meteorology, Remote Sensing Communications, general management, rockets, etc whenever needed, ~~due to~~ such as absence of others dealing with it.

INTERACTION WITH COLLEAGUES & SUPERIORS:

Generally very good - with some of my colleagues and all superiors excellent. With respect to Centres, especially for ISSP it is good. But still due to non-clarification of roles, certain important items cannot be done except through Chairman or purely personal tacts.

SUGGESTIONS:

Horizontalism at HQ staff is an excellent principle. But in HQ ~~staff~~ support team for specific core areas - Satellite, Launch Vehicle, Communication etc - are to be strengthened with clear identity of the lead person. This will greatly ~~help~~ increasing work in planning, monitoring etc. With respect to Centres, the monitoring and planning role of HQ and identity of persons doing this, should be explained effectively by higher management. To run the monitoring and planning activities for ISRO by purely personal skills of individual is not very good in the long run. It saps the energy of the individual and does not allow the system to mature.

All in all ISRO is still a healthy and vigorous organisation; but needs very careful watching.

* * * * *

was INSAT which PPK would like to monopolise (At this point I am attaching appendix the full note to be typed serially given 410(a) ek as it will give a good list of my work

410(a) to 410(h)

At that time a major unrest within the SAC engineers was taking place. Since Wgr Cdr K. R. Rao & B. S. Rao two major senior leaders had been chopped off with a new Director SAC being inducted at a level senior than them ~~two~~ and sent off to ISRO HQ with no role for them. Many senior engineers who worked with Wg Cdr KRRao in ESCES and SCSD division were not reviewed for promotion. The idea would have been to "beat them down" to adjust to the new

management, EVC had no control on them earlier and nor was in a position to take up their case; so far was PD Bhavsar. CA N. Pant, who was under K R Rao was the gainer and he was "the man" to control the crowd for the new management. Moreover he was a timid person and was always a "yes sir" person for his ~~e~~ superior.

It is important to describe about K R Rao (KRR) specially here. His great contributions to the pioneering phase of ISRO, had been

forgotten and he was not well treated by ISRO (even Prof S. Dhawan – SD later).

He was technically sound and a tough project manager. He was obsessed with schedules and performance. He inflicted upon himself also the strict (even much more than) regime, which he expected the team to follow.

He was the person who built ESCES (KRR from Air Force had two deputies, N. Pant (Army) and Kohli (Navy)). He built a team very well. It is based on that work, Sarabhai wanted to bid for Arvi Earth Station

Which was planned for Overseas Communication by the Post & Telegraph Dept (Current DOT). It was to made of huge antenna 95 ft dia, which was needed those days, as the satellites did not have enough pwr power on-board. One of the aim of NASA's ATS-F satellite was to break that paradigm and have huge pwr on the satellite so that the ground antennas were simple 95' ant ESCES was 35' dia. 95' would give more channels with the INTELSAT sahllite.

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As was the custom by the Central Govt. departments in those days (I later found out during late 1980's when I started DST/TIFAC work) that this dependence on foreign technology ~~licen~~ ~~companies~~ and licensed turnkey work from foreign companies — MNC's — without corresponding plan for indigenous ~~growth~~ development ~~with~~ of later versions within the Indian entities/companies started with ~~Nehru~~ Nehru. I have put my research findings ~~wi~~ ~~go~~ without polished ~~wi~~ writing in my website

on Industrial Policy & Technlgy Development in India
www.ysrajan.com article section

No doubt 'Socialist' in the Congress ~~Party~~ party govt. including Nehru brought ~~in~~ heavy industry plants from Soviet Union, Czechoslavakia etc. K.D. Malaviya did a tremendous job of starting oil exploration and ~~for~~ creating ONGC. Even on hindsight those are items which need to be admired. But they, were understandably, unaware of the fast rate at which the technlgy/ engineering development was taking place in the West and ~~in~~ even in

The Soviet bloc countries. They thought they ~~can~~ could buy it ~~for~~ through aid or otherwise. They were not ~~at~~ aware of the unique processes of endogenous technology development processes in firms, industries, laboratories, academia etc. I also learnt it fully only after I got into DST/~~E~~TI/FAC. Our economists / administrators also did not bother about such a complex role. The only politician who knew the processes was C. Subramaniam; but he was junior then. ~~In~~ In Indira Gandhi, he did a great job for Green Revolution & Skill tech.

But Nehru did not have

such an insight. He lumped all of the modern knowledge in 'Industry' and 'Science' — the later with all the romanticism around it. The great Indian scientists of this time like C.V. Raman, Meghnad Saha et al had also little clue of these processes except perhaps Shanti Swarup Bhatnagar. Bhabha also had little idea of the Industry & technology development within firms. He was therefore an advocate of "all in one roof" and the DAE brought about thus did not even letter IIT Kanpur to develop a Nuclear Science & Technology within itself.

Why I ~~era~~ elaborate upon these? One other person who was very junior at the Nehru time but became powerful S&T leader during Indira Gandhi time (IG) knew these processes. He had the experience of running Calico mills. His proposal to have Operational Mission in diverse areas like a Fertilizer Plant in UP etc (some 30-odd) to many ~~make~~ S&T and Indian economy was classic. I have the full paper and have quoted it in many places including my poem on him when he died.

Unfortunately he did not live long thereafter, to make any ~~dent~~ dent or launching a fel- g them. He only managed to ~~get~~ establish a ~~d~~ Dept of Electronics (DOE), which turned to be a Frankenstein of licence- permit - control - raj, post his death soon after the formation of DOE.

But during ~~the~~ his life life time, Sarabhai did not let go any opportunity to learn technology and do operational systems in India. His idea of SITE to follow up with INSAT was that. He put a team with KRR to build ESCES though the UNDP contract was with Japanese.

Indian engineers were not mere spectators. Similarly he was not just satisfied with the free gift of Nike Apache, & Centaure & M-100 rockets from USA & France, & USSR for Sounding rocket experiments. There was a license agreement to produce Centaure through RPP, & RFF. He had initiated the whole range of launch vehicle development in SSTC nearby — propellants, propulsion, etc; not as laboratories to publish papers but to do an operational first satellite launch vehicle for India — The entire

team of SSTC to define SLV under the conversship of YJ Rao was for that.

KR Rao in Ahmedabad played that role for VAS. He ~~had~~ wanted to use this experience with ESCES to bid for an Operational communication Station for India (from one Experimetal ESCES director to Operational Earth Station ARVI). Only VS could think of such a venture. "The suspension of disbelief" — a term used by SD about the ISRO he saw when he took over

was Sarabhai – spirit not just style.

He had a man in K R Rao to do it. ~~As~~ Good bureaucrats sitting in Delhi, protecting the interest of Indian people and the public spending against any risks, could not even imagine a possibility of some Indian group could do such an operational status in India. The Indian private sector was much more risk averse and were also the pious followers of the Govt of India. Even the

Bombay Plan ~~presented~~ presented by the private sector led by eminent persons like J. R. D. Tata (I think it was 1947 or earlier - I have a copy) did not even think of even an equal role for private sector.

So forget any indigenous development for operational or industrial production level. Even Bhakra dam was built under the supervision of foreign specialists! The bureaucrats, being very careful, ~~had~~ had put a tender condition that the

tender conditions were carefully drafted to ~~ensure~~ ensure that those who had not supplied any such stations like ARV1 shall not apply. Well, they are protecting, the govt money, public money from charlatans! & (Unfortunately such conditions continues in all the Ministries even in 2002 inhibiting any technology development or R&D in Indian industry.

Ratan Tata in a Committee set [Secy DST] up by Vasant Gowariker in 1989 had pointed this out as a major problem. V. Krishnamurthy

Committee of PSA in 2002 (or 2001) pointed this out. I was in those Committees). More in appropriate chapters (decades!)

Sarabhai was a man of action. He was not going to wait for moving a paper & Court or write "... to the concerned Secretary in the Govt". He ran with the tender document to P. N. Haksar who was a great power centre those days. (I had the good fortune of knowing him and have a life long friendship with him).

I ~~the~~ heard about their conversation. In those days PRL was so transparent and the broadcaster used by S. R. Thakore with his huge body (he became (more) ~~more~~ fatter later) and loud voice.

VS: "Haksar tell me who is running ~~[illegible]~~ this country?"

~~Hak~~ PNH: (Seeing an agitated VS which was rare)

Tell me what has happened?

VS: "See this tender for ARVI earth station by P&T department. I don't want any concession or relaxation

in any tender condition — performance, schedules or cost etc. But ~~it~~ this tender prohibits ~~us~~ us from applying ~~to~~. Only those who had prior experience of supplying such equipment alone are eligible. ~~I~~ That way no body in India will qualify for ever for any of the new technology products now or future!"

PNH: Vikram, don't get agitated. You ~~want~~ want to bid for this tender. Is it not? You go ahead and do it. I will take care to see that they do not ~~reg~~ reject

the application based on this ~~tender~~ clause of the tender.

Rest good luck to you"

VS was happy and came back. He asked KRR to prepare a tender document and send within due date! It was done! Lo and behold the tender won the other strict conditions including cost and schedules. So the work was awarded. ~~I don't know under~~ It was a ~~contract~~ turn ~~what~~ legal ~~entity VS had applied~~. Key contract by DAE to OCS. ~~Might have been PRL - ESCES.~~

One is win a tender.. Another is to execute it. KRR did it on schedule and within cost. I think I went once

to see Arri Station. In my old papers
~~Arr~~ of 1970's ~~Arri~~ there is
a tour programme from TVM
to Bombay, ~~Arri~~ Pune (Arri)
Ahmedabad etc. in early 1970's.
When in PRL, I had
seen/heard & Thakore telling
& loudly "~~KKRao~~" Wg Cdr
sends ~~Sri~~ stiff letters
to Vikrambhai. Sir... ~~Such~~
such & such ~~is~~ decision is
pending for which I had sent
a note on such & such dates
and two reminder on such &
such dates. Any delay in decision
beyond Such & Such date will
affect the following & bubbles
in the PERT chart and will

to ~~the~~ overall delay by such & such time, for which you will be responsible !! & ~~Are~~ Arey yaar This is the way he sends to Chairman !"

Yes KRR was a tough task master. Even while executing ARVI he had to travel ~~to~~ ~~from~~ Pune - Bombay - Ah'd. ~~He was~~ Often Pune Bombay will be by train / some times by air. He would not stay at ~~the~~ the five star hotel for which he was eligible as Project Executive. He would sit at the airport and sleep there. That was cost - cutting. I had seen him in the later

years at NSRA having just a bunker type ~~bed~~ bed by the side of Director's room to sleep.

We were told that as one of contract conditions ~~was~~ under force majeure clause covers ~~electricity~~ "electricity acts", which was notorious then — all tender applicants would put it — he ~~was~~ had given the responsibility of maintaining a register of power cut — day, time, ~~da~~ time duration — to his Private Secretary, who stays in the Project ~~=~~ site.

Even without having to invoke such clauses, KRK had

completed the ARVI Station successfully and handed over to the Customer Govt department, in time, within cost envelope.

I had ~~ear~~ heard from PRL (Thakore) that KRR wanted the Govt Customer ~~EPP~~ (P&T - OCS) to give a notional deduction for a reasonably good camp office which was built and which was useable for the Station, even during ~~the~~ operation. They refused stating that it was not a part of the original contract. KRR did not want the money for himself or [illegible]

Shri Dinesh Kumar Singh 078-26915847

organisation. Even without such nominal a credit, he was well within the tenders cost in executive which ~~which~~ benefit ~~to~~ ~~[illegible]~~ would go to the customer. Our bureaucracy had always been, barring a few exceptions, cussed. "My point is right!"

Others would have taken it lying down. Not with KRR. He ~~[illegible]~~ auctioned the project building to be taken by someone breaking it down to pieces: ~~[illegible]~~ take bricks, doors, ~~a~~ light fixtures etc and ~~credit~~ ~~[illegible]~~ to return the flats piece of land there back to the customer. The proceedings was credited to

his organisation! He was such a "no-nonsense" man! But extremely good at his work.

~~From~~ Fortunately I got through Google search on ARVI Earth Station, a paper (rare by KRRao) on ARVI in IETE Journal of Research Vol(18), Issue 12, 1972.

"Project Management & Installation of the Arvi Satellite Comm'n. Earth Station" by Wg Cdr K.R. Rao AVSM, Director. Paper received in 19 July 1972. Published ~~on~~ on line 21 Aug 2015 (I think Francis & Taylor has the e-copies of IETE)

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Only first ~~pa~~ page is freely seeable. The paper states

" ARVI Earth Station completed one year of successful operation on 26 Feb 1972 ~~...~~ ... System reliability is 99.9% ~~and~~ it carries 90% of India's overseas communication. It also states that it was taken up as a turn key project by Dept of Atomic Energy to supply to OCS (Overseas Comm^{ns}. Service) ... It states that the electronic equipment had to be ~~no~~ necessarily imported and for which Canadian Agency for

Int'l Development gave a soft loan. There was a DAE-RCA Canada contract for supply of equipment. It goes on to tell about the 97 ft antenna design.

The completion of ARVI was well before VS's death — 10 months before. Seeing ESLES & ARVI, VS being a farsighted man, did not stop at them as they were more than adequate for SITE etc.

But he thought of future of Satellite communications in India & the world. Therefore That

would require many hundreds of ~~I~~ antenna. It ~~can't~~ could not be executed as one-off mode of ESCES and ARVI which were need (ESCES ~~&~~ was in house, ARVI a huge commercial contract being executed for a not-so-supportive Govt agency!!) So VS had created a division called SCSD (Satellite Communication System Division) in addition to ESCES. Division. KRRao headed both, SCSD was to be brought up by him with a view to bid for Earth Stations in India ~~and abr~~ and abroad. That was what KRR was working for

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When VS died. His division would also build Delhi Earth station etc. for SITE (not village antennas which was the responsibility of ESD.

The new dispensation of YP & others in SAC ~~with~~ after VS's death cannot stand a tough (and capable person) like KRRao. So he was sent out. The engineers he had groomed in ESCES & SCSD were also neglected. They might have afraid of ~~this~~ KRR's "genes" in them!

More about KRR
when he did a nasty job
of a report against Y. S. Rao
who should be considered as
a Key pioneer for ISRO's
launch vehicle programme. That
was around 1975 under Dhawan's
leadership. Then KR Rao went
to execute [INDUST] That was
NRSA ...
a great job and again
was in trouble when NRSA
merged with ISRO ... More later.
There is no doubt KRR
was a key pioneer
both for Satellite Communication
and Remote
Sensing in India.

It is sad that in the annals of official publications of ISRO/DOS his name ~~not~~ rarely appears. So is that of YJRao who can be considered the Chief Architect & Engineer of the Sriharikota Range of ISRO & ~~defiver~~ delivering first SLV-3.

Coming back to SCSI, & ESCES they got step-motherly treatment in terms of considering the engineers there for the promotion which was due to them. Also some amongst them could have been chosen to be the SITE Operations ~~Engr~~ Manager/Director. That also was not done. Their leader had been hounded out. In such a situation one Jai P. Singh was brought from USA, to be SITE

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Operations Director. ~~That took~~ He was an IIT Kanpur B.Tech. and gone to USA for higher studies as was the practice of many Indians then. ~~But he had~~ When considered the totality of his qualifications and experience ~~in~~ ~~USA~~ he would not be eligible for more than an SD grade in ISRO. He was given SE grade, while many in ESCES/SCSD ~~were~~ with much more experience were languishing in SD, SE grades and without being called for a review for promotion. There was a major strike in SAC. ~~The~~ The management was afraid of discussions with these senior engineers. I had

arrives at such a time to
Ah's. I was welcome to these
agitating groups. I had some
friends there; most of them knew
me. In a way my case for
promotion had not been taken up.
It sh'd have been done when
I was in USA. Delayed by several
months. YP told me privately that he
would not like to do it along
with this group but after they
finished with the considerations
of this group. Some more
wait for me.

The agitating engineers
knew that I was also like
them; no special god-fathers to
push me up; my going to USA

was a normal process: I got a chance only after my senior Calla declined. They also knew ~~I~~ that I would not do anything against their interest. So I was the only one who moved around with both warring sides. I did not even a ~~R~~ room to ~~A~~ sit. I used to get my notes typed in YP's office and give him or send to ISSP etc.

I had to travel to B'lore to go ISSP. Some times when ISSP car did not come I had to go all the way in an auto (from the HAL A'port — now called old; then only one!) to Peenya Industrial

Estate; horrible ride through several pot holes. Also getting all the fumes. I had long flowing hair then ~~too~~ (inherited from the US stay as it was the post-hippie effect in USA with many elites having long hair. Bill Redisch had one). But I did not have a beard. It was more a prominent hanger moustache 2.0 The long hair will absorb lot of smoke & dust in the exposed auto!) My job at ISSP was to review documents, discussions with PyCRR & concerned persons; seeing the lab. And importantly to work out detailed schedules for the supply chain. Such a mode

of working was the same semi-formal mode in which I was helping ISSP & URRao from USA. Things for me were in a state of suspended animation.

Similarly I would help YP in reviewing many proposals / ideas which ~~are~~ were sent to him. ~~I~~ Above all for SAC, I helped out to have ESCES spacecraft compatibility tests for ATS-F and SITE experiment. Lett of EVC dt Feb 1974

~~Even whe~~

Even when the strike was going on at Ah'd, ISD desired to come there, after recovering from herpes he suffered for several weeks, ~~t~~ and solve the problem. Vellodi as Addl. Secy of the DOS advised him against and the situation could get ~~nasty~~ nasty. Therefore my meeting with Prof SD which had

due to his herpes, had to take place at the Centaure hotel near Airport in Bombay. I went there. I don't remember the exact months or date. It should have been [late December 73 or] early ~~Jan~~ 1974 (mostly before Feb 74 ESCES tests which would not have been possible when SAC engineers were on undeclared strike).

I don't recall any fear or nervousness in me in seeing ~~Dhawan~~ the new Chairman ISRO, about whom I knew precious little. May be it was an innate confidence which I had right from ~~the~~ my entry into or being in PRL. Then my interactions in VS was a great learning period for talking to "big men". Then of course, the excellent experience

in USA.

SD was alone when I met him. I don't recall all the conversations. He was an impressive person, very different from VS. He started explaining the important activities of ISRO — ISSP project, SITE experiment two immediate items and evolution of launch vehicle in VSSC ~~which was~~ where SLV-3 was getting projected — and to plan for INSAT and future projects. He said that ~~any~~ the desire to use my experience and expertise in ISRO & NASA to help him at the ISRO Headquarters to manage ~~plans~~ these programmes and plan for future. He therefore

wanted me to be at the Headquarters. He quickly added, (which I later learnt was typical of him!)

" Of course, UR Rao wants you to help, Yash ~~needs~~ ~~you~~ ~~and~~ wants your help.. You can do that also. You can divide your time and do it. Over a period, do more at the HQ"

Nothing could be vaguer as to my posting! More importantly where I ~~will~~ would stay etc. Nor did he explain the type of work at ISRO HQ in clear terms. "Come on, we will build it up" — was the type of message, though he was

talking most of the time.
Probably he himself was
evolving and had no clear
picture of how he would
plan to build the headquarters.
In a way I could not ask
any specific questions on
the elaborate talk! It was
almost getting clear that he
would not let me go out
of this decision to have me
at the HQ. I remember what
Greg Andrus had told me.
Almost spontaneously
I said, "Thank you Sir, for
your kind consideration. But
all over ISRO, there is
a feeling that ISRO Headquarters

is a morgue." (Background to this is that BRR who had some vigilance cases filed by ISRO was at HQ. So were the two fallen stalwarts KRR & BSR with no assignment. I heard also about a Rani Sharma (who came from USA) who got out of RSMD was shunted off to HQ. I was hearing that to solve SAC's agitation over promotion & JPS appointment as Opns. Director SITE, JPS would be sent off to ISRO HQ. Only regular person, in a way right inheritance from the earlier dispensation, was Prof PD Bhavsar)

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I don't think I had any fear in telling such a blunt thing about HQ to Chairman ISRO who was talking about building up a HQ and desired to join!

~~&~~ He almost swung a full 180° in the swivelling chair, after several tens of seconds ~~Su~~ swung back with his left & right hands alternatively scratching his elbow ~~(at~~ (another characteristic of him, I learnt later, when he had to deal with delicate situation) and

"Well, I saw my face and said "Well, it depends!" It was a classic reply. It did not get angry with me. Nor chastise me "What for example "What do you know? You are just back from USA after being there 3 years!" etc. He accepts the reality. The phrase "it depends!" had many meanings including as to how I deal with the reality and shape things.

Then he talked for a while on various things of ISRO

and told me." I would talk to Yash ~~S U~~ so that one can decide how long he ~~need~~ needs you there. ~~That~~ Then you can move to Bangalore permenantly. Till then you continue what you do for him & of Rao. Then we will see in Bangalore".

So that was a great turning point in my career: From hardware & Systems Engineering to System Management and Programme management at Corporate HQ level

My desire to develop satellites and have them launched would probably go away. I would be far away from the project management of satellite construction, testing or earth station etc. I would be at a "higher level" in managerial terms but I was young — on record crossed 30 years but yet to be 30 ~~year~~ (April 1974 was when I turned actual 30)

// After a decade of fast movement in career from 1964 to 1974, ~~was to take~~ it was now going into an unknown territory, something really unknown in India's S&T System. The seeds,

, the saplings, which VS put was growing fast. I had played my role in tending to some of them and make them grow faster. ~~So for SD it was~~ ~~a~~ SD inherited a fast moving, fast growing organisation with a lot of energetic and passionate individuals. Though broad goals for the organisation had been spelt out and some projects defined, it was not clear to SD (who had an analytical mind) where ~~the~~ all elements ~~we~~ ~~have~~ and their interconnections had been identified. VS's HQ (of EVC, PDB and a later addition of Kiran Kavikto assist EVC) ~~Sanjeev at AL~~

and the ubiquitous S R Thakore) was not adequate to grapple with the issues. There was no road map. SD ~~cannot~~ could would have thought that he could not have it with ~~PP~~ PDIB, Vellodi & T N Seshan alone. The ISRO Council he had ~~for~~ former was more ~~a structure~~ a steering management Committee (a participative one) to take urgent decisions. It could not give the ~~analysis~~ analytical framework and technical depth, which SD was looking for. (These are interpolations by me after

the working methods of SD and how his mind worked, after several years of working with him at HQ).

~~To use some~~

It was a "historical necessity" for SD to have formed an ISRO HQ, to grow ISRO, to manage it and to give "guidance & control" to it ~~in the~~ during his fast movement. He would also sensed among the passionate pioneers who comprised ISRO, many conflicts, jealousies etc. VS had his method of managing the conflicts (or "management by conflicts")

SD needed a "heavy" armour of analytical reasoning to control these powerful ~~for~~ conflicts towards productive channels.

I think a couple of months passed by with me ~~total~~ shuttling between Ahs & Bangalore. Uma & Vijay were in a way enjoying at Dharwad as ~~it~~ she was with her parents, Vasanti ek after a long time. It was not easy for Uma to handle Vijay at DHG, since he could walk run etc. She told me later as to how one day he came back from the military nursery school nearby their home.

She thought he won't enjoy in a school and she had put him there; they all knew Maniyan & ~~Guru~~ Goma ben. ~~They~~ One day by they returned after putting him in the class and settled at home. Within about 20 to 30 minutes, he was back home with his school ~~bag~~ bag! She was shocked because he had to come through a railway crossing (gates & manner of course!) Vijay was always good in making drawings (even though many markings won't have been in Gujarati).

They then stopped ~~that~~ sending him there. One of

The biggest problem Vijay would have faced there was language. He only knew good American English; the children there would know precious little. He was a good social child! How could he communicate?

Gowa also would have liked to settle at one place. I could not even talk to her in phone. Already Ab's DHA lines were bad. With general chaotic situation 'andolan' things were worse. Even by booking a lightening call, I was not getting a line.

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One day YP called me "Rajan, ~~[illegible]~~ Prof. Dhawan had told me that you can be here for six months or so. By ~~pressing~~ him I can do it more. But he is bent upon having you at HQ. So I do not want to make your life much more miserable with Guna & Child alone at DHG and you shuttling up and down from Ah'd to DHG. Though I hate to lose you, you go ahead to Bangalore and try to settle down & take Guna & the Child soon! I will inform Prof Dhawan also." It was very kind of him.

I went to Bangalore, working at ISSP & coming a few times to HQ. I met Proj Dharam also. # I was also seriously looking for a ~~#~~ place to stay. People were (in kindness) confusing me with many options, at Rajaji Nagar, Seshadripuram etc. Many of them advised me to have an independent house with mosaic flooring, 2 or 3 bed rooms. Proj EVC had advised me "Rajan: don't take ~~a~~ house with rent above your HRA, though the extra may look small; each year the land lord will try to

the rent rises. If Govt DA raises, they will ~~have~~ raise it much more. Govt HRA rises only slowly. Soon you will find that expenditure on rent become very high!"

It was a useful advice, some thing Periappa would have given. I followed it. Most of the full mosaic houses were costly; if they were within my HRA, they were far away, or isolated. Also since there was a craze for 2 or 3 bedrooms and the number increased the rent, the land lords were building very narrow rooms! ~~I saw~~ ~~One~~ When I was in such a

confusion for a couple of weeks,
Prof Dhawan told me: "Rajan,
each person will keep on
giving advice. Don't take something
in a hurry and regret later.
I can help you ~~in~~ ~~in~~ by
giving ~~a~~ you a temporary
accomodation in ~~India~~ IISc
married apartments. It is
meant for IISc work only.
But as a Director, I can
give you for six months.
For all it is the maximum.
But one thing: you should
vacate it exactly on or before
the date specified. Another

resident will be in the queue. Do not embarass me as that count. Take it; bring your wife & child with minimum vessels for cooking as you will only have a kitchen, bathroom & a bed room. Also ~~they~~ are can eat in the guest house ~~eat~~ canteen. Look for a house within <u>six</u> months & move!"

It was a great relief. It is <u>not</u> normally given to ISRO persons (or ~~A~~ non-IISc relates work). So Uma, Vijay & I moved into Bangalore.

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Check with Cuna

It would have been March ~~or~~ or April 1974. I had engaged a broker to find houses. I put some simple conditions: some doctor nearby home, walkable distance even at night (this was because we had Vijay & phones were rare, that too at home!); a (good English medium) school nearby. Some transport access nearby like bus / auto. Dr Ravi Sharma who was at HR. ~~help~~ helped. He was staying at Lower Palace Orchards. He told me: "Rajan I will help you; don't go by full mosaic

or independent housing. Park mosaic & red-oxide are good enough. Other ~~a~~ three conditions you said are vital. I will tell the broker to look around Upper & Lower Palace orchards. The owners may rent a ground floor or first floor." In those days, most houses had only ~~one or~~ ground ~~to~~ floor or a first floor. Even a second floor was rare.

I still remember how Rao brought me to the house in ~~the~~ Upper Palace orchards, through a heavy rain in his fiat car. The owner Hallappa

stayed at the ~~the~~ ground floor;
a retired ~~income~~ income tax or
revenue officer (Asst or Dy level)
Simple man; mostly spoke
in Kannada. A reasonable
size living room and two ~~two~~ reasonably
large rooms — mosaic; a
balcony mosaic (reasonably big)
Then kitchen, shore ~~room~~
typical traditional style including
a bathroom with
a big ~~big~~ pot for hot water
(to be fuelled by charcoal
or fire wood). No attached
bathroom; one latrine outside
~~this~~ at the end of the floor,
Indian style.
But the location
was good; satisfied the 3 conditions.

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Rent (negotiated) was brought down just below ~~our~~ my then HRA.

So we moved; the material from DHG came after a couple of weeks by trucks (including the ones we had ~~go~~ brought from USA).

Opposite our house was a (lady) doctor; simple person, MBBS. Gorna & I discussed about the school. Though big names like Bishop Cotton etc were there, I felt a nearby one is better, especially for a child going to go to LKG / UKG. But that means subsequent ~~lesson~~ classes

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may have to be there. I did not think of such a long term especially our life since 1969 had been on the move. Who knows, what will be the next move? Also any "socialist / communist" orientation ~~boot~~ meant a reasonable ~~g~~ school nearby is better instead of chasing ~~e~~ "elite" ones! Also I felt a State ~~e~~ level school was better than chasing Central Govt. or ~~ten~~ Central govt. curriculum. CBSE was not so much sought after. Also we would not qualify for Kendriya Vidyalaya etc. — which were

also rare. We liked the upcoming Poorna Prajna school which was very nearby, looked clean and only partly built. As per their policy (then) of taking students nearby, we would be eligible. Goma ~~said~~ ~~of~~ handled school admission. It was ~~very~~ simple then. The parent~~s~~ has ~~to talk~~ take the child and they do some simple tests of speaking, some geometrical figure identification etc. Goma told me that there were a few parents with their kids and she also went and ~~sat~~ stood there with Vijay. Vijay was not the

one who ~~can~~ could ~~sti~~ ~~st~~ sit idle or would be afraid of a new place. He started commenting on things and asking questions to his "mumma" — fluent English. He drew the attention of the ~~P~~ Principal immediately and she called Goma and asked about Vijay. Goma told and said she wanted admissions. Principal said his speaking & knowledge ~~are~~ were ~~very~~ very good. She ~~and~~ told ~~gave~~ her to pay the fees and take the admission card. So Vijay had his school. Six years later

When he had to admit Vikram (not born ~~then~~, in 1974 but in ~~1997~~ 1977 and therefore for admission in 1980) the whole story was very different! The school had grown, demand very high! ~~I~~ Story on that later!

* * *

There were lots of activities at ISSP and some at ISRO HQ. At HQ the persons from ISRO were BRR, KRR, BSR (known to me earlier) and PDB (though full time, he was an occasional visitor; also B'lore weather caused him asthmatic attack ~~2~~ for me asthma had practically disappeared). JPS,

Rai Sharma (RBS), KS Prabhu, V. Siddartha, P. Sudarsan were new to me; they were also new to ISRO. Three young MBA's from IIM-Cal (S. Chandrasekhar - Chandra), IIM-Ah'd (S.B. Iya) and Kalyana Raman — IIM-Ah'd (Kalyan) were new recruits; they joined around June 1974 (almost the time I had seriously got into ISRO HQ). Another was Dr. Nandini Raghavan (a physic PhD from IISc). There were others brought by Proj PDB from PRL, Dr. M.S. Narayanan (MSN) Dr. S.C. Chakravarty (SCS), Dr. S.K. Dalta (SKD) (PDB was mostly utilising them for allocation his Scientific Rocket work)

At the Dept of Space, all were new to me ~~Vellu~~ except Addl. Secy Velludi whom I had met at USA. Other persons was T.N. Seshan Joint Secretary. The other officers were P.A. Menon Dy Secy, Venkataraman (Under Secy) etc. N.V.G. Warrier who was P.S. to VS was brought into Headquarters as Admn Officer — all in all to run the Admn. of ISRO HQ & he had some assistants. I knew NVG right from my PRL days.

There was little of allocation of work. Prof. Dhawan Then because of the demand of

some persons like JPS, P of SD made an SPAG (System Planning & Analysis Group), noting ~~the~~ the existence of such a group with ~~VI~~ VS when he was Chairman DAE/AEC. ~~&~~ & PSudarsan (PS) ~~kn~~ knew about it as he was originally ~~recen~~ recruited for that or he was aware of that through ~~Kirit Pa~~ Kirit Parekh. (who later became ~~a great~~ an eminent economist and energy policy specialist; was Mentor-Planning Commission also. How would SPAG work would be integrated with ISRO's ~~work~~ (then current)

activities and evolve future activities. But it gave a platform. Some persons excluded from it at HR, were feeling bad. So it became a status symbol. There were some meetings of SPAG and minutes. (It would be good to read some of them in ISRO archives as they may give some clues about the origins of ISRO HR). None of the Chairmans of ISRO had (have) interest in having a professional study/research on ISRO HR ~~archives~~ archives. Mostly they were (are) engrossed in themselves. In general time for for Indian bosses (~~for~~ and

political leaders) history starts ~~(ed) with~~ with their taking over and ends with their demitting of office !! They would not like ~~exact~~ external (fact bases) look at these events !!

Amidst these general activities (confusion) of ISRO HQ, Prof SD called me one day & and said: "Rajan, though you are in HQ, you concentrate only on the progress of ISSP Satellite; Spend more time there. The project is entering a crucial phase.

In about a years, it has to get ready for launch. It is not enough of that URRao briefs me once a week or calls me to solve some crisis. Nor is it enough with the ISSP Board which meets in a month or two. That is more for solving some admin. problems and to give some financial or procedural approvals.

You need to get into every technical detail; how the subsystems are evolving. Any major problem in test. etc.

Fortunately Rao has trust in you. He will not allow anybody else to come near the project. I do not understand the details of electronics or various details of satellite performance. Initially you give me detailed notes of all good items and worrisome items. I will hold weekly reviews or even more. You don't talk there. I will put all the difficult questions based on your notes. Rao may know that you have given me the questions; but we have no other options."

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Thus I had a "double life" with ISSP projects. One solving problems ~~for~~ which URRao refers to me; and secret also looking for possible problems, which I cannot tackle through talking to URRao, and therefore need a resolution at SD level. The secret ~~re~~ part ~~was~~ was a delicate issue. I shd not flood SD. I should try to solve as many as possible in some way diplomatically with URRao. And take only

some critical items to SD. This process went on for some ~~time~~ several weeks. SD had ~~to~~ reviews of ISSP frequently, sometimes two or three in a week. On some questions, CRRao ~~with~~ would get angry. SD used to handle them. But the message had been given: CRRao was a very intelligent man. His anger was more because that he did not catch it! ~~Anger~~ If I had told him also without ~~he words not~~ coming through SD he would not listen. Even before

I explained he would have diverted the topic!

In the overall ~~it~~ SD acted like a Super-Project-Director, though he was not interfering with the daily work of URR; nor did he undermine his authority. After all it was URR who was worrying about the project every minute (It was more than 24X7). He had energy to run around the sheds to find out problem areas and fix them, then and there. He ~~was~~ had taken up an impossible

schedule for the sahllite. No body had prior experience in Indra. The review by Soviet scientists were limited to about once-in-three-months type review. They worries about their interfaces only. The details of subsystems were URRao's headache!

SD's reviews were only to help URRao to get a detached review of details, which he could miss because he had to run around all the while. In a way SD & me were acting as a special staff for URRao.

But URRao's personality was such that if that staff were under him, he might brush him / her off, when he did not like certain things! But he could not ignore SD as he was his boss. SD had a full psychological profile of URRao and hence adopted this mode. Amidst all these views and my direct help at the ISSP, I had a delicate job of not hurting URRao not to diminish his trust on me.

He should not think of me as a spy for SD! (Chairman ISRO) I had enough of social skills to take care of that. Greg's advice also helped." A ~~sy~~ good systems engineers / systems manager should not push any thing as his ~~idea~~ idea. Introduce it through somebody else as if you are not involved at all!"

Satellite subsystems was entering into prototype / flight model phases. This ~~will~~ would require lot of systems discipline. No longer

a quick / instant fix mode
in which UR Rao functioned
and to his credit brought
the satellite to this stage
now. Now onwards ~~each~~ each
anomaly had to be recorded,
considered carefully by technical
groups and then decide changes.
It was called "configuration
control" in NASA management
jargon. SD & I discussed it.

SD later told me "Rajan
I tried with Rao ~~to~~ to convince
him that ~~now~~ now onwards
he should not give solution but

have a Number Two person
who would do it carefully
for him & report to him
later!" ... ~~Then~~ Very next
day, he called me and
said "Raj Dharan, I had
named Kosta for that ~~post~~
Number Two job which you
said. Technically Rao
is right. ~~It~~ Kosta ~~was~~ is
the senior most ~~in~~ Technical
officer after Rao. But you
know him. For every thing
he ~~will~~ will run to Akbar.

Actually he had kept Kosta for that only, even for administrative matters. But that is not enough for us. Think of a system in which such well considered (independent) ~~Opti~~ considerations of anomalies can be done; solutions given. It should be away from Rao. ~~He~~ I don't think we can have somebody from outside ISSP. They won't know, they can't function. Also I don't want the progress stopped, as we have a

very tight schedules before us.
Find some solution and convince
URRao and we can have
him ~~issued~~ issue the order."

That was a delicate
job. Some thing not done
in NASA etc, as they had
independent directorates in their
~~sche~~ centres. The Project Manager ~~cannot~~ could not
do any thing he wanted. But
USA had lots of persons with
adequate knowledge & skills
in satellite making. But
we now have them ~~in~~ only in
ISSP. PPK ~~will~~ would know

some elements. Firstly he won't come to Peenya sit and also by his very personality would end up in a fight with UKRao. I could not go and sit to do this ~~24X~~ 27X7 job (ISSP really worked day & night and even on Saturdays & Sundays & UKRao had arranged for juice & milk in addition to free dinner for the night shift persons). It was something unique in those days. Things were scarce too!)

Also I had to ~~do~~ ~~ab~~ do the overview function for the project which result in regular SD's & review. I could not get involved in details execution of a small but important part. I was in addition had to help ISRO to procure some critical components, which involved special coordination with ITI (Once I had to go to USA too!)

After a lot of thought in terms of the Satellite Systems Engg requirements, the way the

ISSP
delivery groups had been arranged (equivalent to vendors in NASA terminology) and other sensitivities a system was arrived at. We could not copy the NASA ~~system~~ system of Sub-Contractor; ~~all~~ it ~~is~~ was as if all the vendors directly reported to the Prime Contractor/ NASA-GSFC Project. It was also necessary that the detailed system creators should have detailed knowledge at those dis-aggregate levels. Those who are specialist in digital systems cannot be put in Power or R-F etc. Fortunately since there were detailed

splitting into telemetry, telecommand, R-f, antenna etc, one could achieve ~~a~~ a degree of independence ~~from the~~ when people evaluate the anamoly and also had knowledge to give a solution.

After a few rounds and broad discussions with SD and detailed rounds with URR, an order/memorandum was issued by URR himself, which literally delegates his technical supervisory power to the lower most functional operational levels; still maintaining a level higher in a Committee ~~Audit~~

which was again a buffer between URR & the system of anomaly ruling. ~~It~~ The system so created was such that ~~each~~ most problems can be ~~Corrected~~ considered/ given solutions at those levels closer to them without having to refer to any body else. One junior person with common thread ~~will be~~ would have to access to all of these decentralised decision, thus fulfilling the overview functions.

This memo dated Aug 7, 1974 ISSP/25/65 ~~About~~ by Prof URRao should be

considered as a landmark in ~~Spt~~ introducing "systems" in Satellite Projects in ISRO — in the very first one itself. It was a Q&A, Configuration Control, etc put together. For some reason, as it did not belong to ISRO HQ files, I have even now copy of it with me — an old cyclostyled copy. The title is "Test Programmes and Configuration Control Committee"

The preamble para 1.0 states: "The various tests done

in the Indian Scientific Satellite Project have to be critically examined for any anamolies ~~major~~ either major or minor. The process of deciding upon the nature of these anamolies and resolution of these cannot be left to the test engineers nor can they bog down the Project Director. This process has to be formalised and also systematised. This job of solving the test anamolies and suggestions for corrective actions require all the talents

of the Project, and in order implement these, the following system is thought of.

2.0 The ISSP activities for Test Programmes can be categorised as:

(i) Telemetry subsystem tests
(ii) Telecommand " "
:
:

(xii) Post Launch Operations
(a) Software
(b) Hardware.

It ~~is~~ is a seven page order. It goes even to the details of copies to be sent to

whom. P.D. & Kosta ~~[illegible]~~ are
also specifically mentions....
It has an accompanying
memo same date, giving
the procedures to be follows.
which starts with a para

"The wiring of flight model,
PC cards, and assembly is
under the control of system with
on line inspection of Q&A. No
change in the circuit wiring
is allows henceforth unless
approves by the Sub-Committee or
Committee."

By and large thus

System works. It requires considerable discipline on Prof KR himself, as individuals used to come to rush to him, as was the practice before. These procedures also created systematic documentation to refer to the ~~that~~ anamolies all through upto the launch pad & even for post launch. It also helped all the engineers to develop a systems knowledge of satellite: would have been of great help in their designing future satellites.

It is also to the credit of

(507)

SD who ~~had a system~~ liked to a system overview and at the same time had a keen sense of "attention to detail". On his table he would arrange things meticulously. Sometimes, I used to shift them to keep a large number of files. While getting up, sometimes I had not noticed. He would rearrange ~~at~~ them! ~~I do~~ That was a lesson, though my table when I was at the peak of my work as Scientific Secretary could not be so organised. But I ~~k~~ could retrieve any ~~things~~ thing ~~within a~~ well under a minute.

Similarly, when I see a photograph ~~hung~~ or a picture frame hung even with a small

slant (often a fractions of a degree) in it disturbs me (even now!). I will go & try to correct it. SD used to tell me that I have an engineer's eye! His definition of a "perfect engineer" with attention to detail.

Coming back to this ~~orde~~ memo by URRao, this was the result of what SD was ~~also~~ slowly introducing with ISRO. VS was an entrepreneur; he starts many items; places people; often with competition (conflict?!) so that the idea ~~was~~ not lost with a person; he injected lots of energy into the system and this

people. Many things took off;
expertise got built up in smaller activities;
~~Some bigger projects~~
even ~~the~~ the transponder project
built that capability; many small
~~than~~ indigenous changes done
by Kalam & group to the rocket
experiments, added to the early
phase of expertise building; in
some cases like Arvi it directly
~~it~~ got into the users. Rocket &
Satellite technologies were more complex.
The initial steps were to be
taken through the first Satellite
& first Satellite Launch Vehicle (SLV) ~~3~~. He
passed away at that stage.

How he would have
~~did~~ managed things further can only

be a speculation. In his mode used at the beginning of ISRO, were that many different groups, each fiercely independent, competing for ~~the~~ their spaces and reporting directly to Chairman ISRO. The so called HQ had only three senior persons: EVC, PDB, & SRThakore (SRT). EVC & PDB hardly ~~did~~ received any technical activities; PDB was concentrating on allocation of Sounding Rockets to the scientists; SRT was sought after as he was the allocator of budget after VS approved, often orally after one to one meetings with the individuals

who proposed various activities;
of course, with written proposals.
by rarely they were reviewed
formally. The TCFC which was
set up for SSTC, was ~~to~~ more to
deal with administrative/financial
matters and not technical
analysis.

Actually what was
happening within ISSP was
~~a replica~~ a (microcosmic)
replica of how early ISRO
~~was~~ worked. Technically
ISSP Project also was a part
of VSSC which was under
Director VSSC, (Dr. Brahm Prakash)

SHAR also was under him with an ~~invo~~ innovation of SHAR Board which he chaired with the SHAR Common Facility (SCF) being ~~bein~~ taken care of by Dr. Y. J. Rao (which was also overseen by SHAR Board)

The entire VSSC was brought under a systematic working by Dr. Brahm Prakash (BP) More about it later. He had once told me "When I took over as Director VSSC, there were many proposals I just signed and approved many recruitments just because every one who ~~for~~

~~[illegible]~~ came to me with papers would say "Chairman had approved". ~~It~~ That is VS approval. It will not be right for me to question or reexamine them. So I signed. Over a few months I realised it was not correct. Many items which VS & just liked, had also been taken as his approval! So I started examining them!" That ~~to~~ was the start building systems in VSSC, which was thorough and systematic. Of course, they had the advantage

of having many senior persons with technical backgrounds and also ~~of~~ experience gained in ISRO (~~INCOS~~. SSTC through various activities ~~and the large~~ They also had a large number of young persons who could be asked to do the necessary analysis to meet the rigour of the systems created by BP.

Another advantage was that they did not have a major (by the then ISRO standards) Project with "killing" schedules ~~of~~ as it was with ISSP. There was a great political pressure and ISRO commitment

to have the first satellite launched in 3 years and the agreement with ~~the~~ USSR was also a pressure. So the VSSC could afford to have ~~That~~ some (relatively) relaxed mode to build up proper systems, reviews etc. BP did a remarkable job there. Had he not taken care of that huge chunk of ISRO so efficiently and effectively, SD would have been inundated with ~~first~~ daily fire-fighting calls. He had the big Field Marshall to take care of ~~it~~ the whole of TVM & SHAR.

What was left in ISRO was SAC with its SITE experiment which was also scheduled for 1975, ~~and~~ and ISSP for India's first satellite scheduled for early 1975. YP was "taking care of" SITE; ESCES compatibility tests were over; for FEC (Front end converters) there was some ~~fire~~ fire-fighting, but NASA had stepped in to help and to transfer to ECIL for production. (ECIL had its own lethargy then). Delhi Earth Station (DES) was to be built; though KRR had been ejected out the team he built could take care.

Only "vague" item was the software (we used to call it tender ware, as it is those days wired - computer - imbedded systems were called 'firmware' & 'Software' was for external loading. So we wanted to differentiate the TV productions, differently. It also involved many artists etc.) This was some thing which YP relished. SD left it to him! Difficult to evaluate in engineering terms!

So the most critical item was ISSP - also some thing very demanding. Once

satellite ~~to~~ was launched, we could do precious little. So we had to build in all the reliability; we had to avoid as many problems as possible, through reviews and through tests. It was too late for ISSP satellite for reviews as it had to evolve. They could not afford the luxury of Phase A, Phase B, Phase C studies. CERS had to jump into Phase D directly, that too without the rigorous documentation of specifications, ~~parts~~ parts list etc as it was for NASA satellites say ATS-F (which was of course

a very complex satellite — might have been 50 to 100 times more complex that ISSP. But all the same satellite is a satellite. One mistake some where or one "chalta hai" for a test anamoly — can disable the whole satellite. Also this was the first one for India!

Any failure would be disastrous for ISRO.

This was at the top of the mind for SD. That was why he was concentrating on ISSP, though technically it was under VSSC & BP. He would have told BP on that

and BP also would have seen the need to be near the Project all the time; that filters SD overseeing etc.

For SD, ISSP became also a training / experimental ground for evolving systems & engineering / system management ~~system~~ principles, systems and practices for ISRO. His experience and BP's system in VSSC would merge together to evolve systems which are prevalent in ISRO.

SD's methodology was analytical. He would like to break down the systems into

subsystems & further down.
He would like to understand
the ~~systems~~ interconnections
and especially their functional
impact at the ~~the~~ system
level. How ~~does~~ would they
impact the mission goals
(for which the system is
being built).

Therefore attention to
details ~~are~~ were crucial.

At the same time,
being a practical manager
he knew that he should not
be getting into all the details
at those disaggregated levels.

Therefore he had attempting to have an "informed system integration" which ensures (& enables) that the lower disaggregated levels also worked with the same system algorithm (towards ~~=~~ realising the mission goals for which ~~is~~ the system was & developed / put together)

Each of the disaggregated levels had a lot of freedom to function, but all the while feeding information of its ~~function~~ functioning to the system as a whole in a pre-arranged manner.

It was the role of his HQ to function at the apex of such a system without losing touch with the realities of the disaggregated levels (whether it was at conceptualising stages, or planning stages or subsequent execution levels).

I had such an experience while doing ISRO-MIT studies (conceptualising stages) and at ATS-F Project for other levels. So for me to arrive at such a system at ISSP was not difficult; but the