

Indigenous Equipment and Systems

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ABSTRACT: *The efforts taken by ISRO/DOS towards realisation of its goals, with particular reference to the technology related to remote sensing are described in this paper. The attempts to capture the emerging remote sensing applications market, through indigenous developmental efforts and productionisation by Indian industries are discussed. The role played by industry in the successful transformation of ISRO/DOS technologies into market-acceptable products and in the development of the market itself is also explained.*

INTRODUCTION

Guided by the twin objectives of self-reliance and development-oriented applications of space technology, the Indian Space Research Organisation (ISRO) and Department of Space (DOS) have been consciously pursuing technological innovations in a wide range of disciplines. The major thrust of ISRO/DOS activities has been to provide space-based operational services in a number of areas relevant to national development. These include telecommunications, TV distribution, natural resources survey and environmental monitoring. ISRO/DOS, in its pursuit of the above activities, is involved in the development and operations of a number of sophisticated satellites and a range of launch vehicles to place them in appropriate orbits. Ground facilities for satellite operations and launch services have also been developed and established by ISRO/DOS. Consequently, a number of technologies have been developed in various fields, which represent an important national resource. ISRO/DOS through its technology transfer scheme seeks to encourage greater use of this resource by providing a link between technology and industry.

The major goal served by the technology transfer scheme has been the servicing of the rapidly expanding space applications market in India, catalysed by the space programme, in the fields of satellite communications, TV and radio network, meteorological observations, remote sensing for

natural resources survey and management, environmental monitoring, etc.

REMOTE SENSING APPLICATIONS

Use of remotely sensed data for various applications began in India almost three decades ago. In keeping with the ISRO's philosophy of phased ushering-in of the operationalisation of new techniques/systems, through development, experimentation, demonstration and validation in coordination with the user agencies, a number of developmental efforts were taken up in ISRO. Particularly, ISRO's approach to space applications has been to convincingly demonstrate the utility of the space-based technology/techniques, before entering into large scale investments in space. Accordingly, in the demonstration phase of the space-based remote sensing applications programme, the Landsat data and remote sensing through aircraft surveys were fully exploited and a number of joint experiments carried out with various user agencies, ranging from Agriculture, Hydrology, Forestry, Fisheries to Environment. In addition to validating the applicability of remote sensing data for different disciplines, this phase also provided insight into the instruments and systems required for the data/imagery analysis by the concerned scientists. Realising the large market that would follow, once the technology is accepted by the user agencies, and the need for having them from indigenous sources – in keeping with

ISRO/DOS objectives, the development of such instruments was a natural consequence.

PHOTO-INTERPRETATION INSTRUMENTS AND SYSTEMS FOR REMOTE SENSING APPLICATIONS

The development of the appropriate instruments and systems for remote sensing applications was taken up at Space Applications Centre (SAC) and National Remote Sensing Agency (NRSA) since the early phase. The initial approach to remote sensing data analysis was essentially visual interpretation (imagery) based. Therefore, in order to cater to the demands from different user agencies, the following systems were developed and the technology transferred to the industry for mass production purposes:

- Optical Reflecting Projector
- Diazo Printer
- Large Format Optical Enlarger
- Multiband Ground Truth Radiometer
- Map Master
- Multispectral Additive Colour Viewer
- Light Table with Coordinate Measuring System
- Viewing Desk
- Colour Composite Printer
- Illuminating Magnifier
- Optical Pantograph (Figure 1)
- Spectroradiometer
- Agrophotometer (Figure 2)
- Microfiche camera
- High Magnification Enlarger
- Optical Transferscope

The Photo-interpretation instruments and systems are unique, since they have been designed to meet the very specific requirements of the Indian users. Most of the enlargers and projectors serve not only to delineate tiny mapping units, which otherwise may get merged with the contiguous large units, but also provide for projecting the image onto the Survey of India topographic sheets, which are the base maps used for all visual interpretation. Similarly, the photometers and radiometers cater to the spectral regions which are covered by the satellites available to the Indian users for studying spectral profiles of the earth's surface resources. The identification of such instruments has been based on the user feedback and need.

INSTRUMENTS FOR DIGITAL IMAGE ANALYSIS

In the early phase of remote sensing applications, the digital analysis called for main-frame computers due to the complexity of the processing as well as large data volumes to be handled, and consequently



Figure 1. Optical pantograph.



Figure 2. Agrophotometer

non-affordable by most users. However, the emergence of smaller computers (mini and micro) with substantial processing power prompted ISRO/DOS to examine the potential of digital image analysis using

such inexpensive computers. It was also clear from the emerging trend that the digital processing would be the key requirement in future. Therefore, the Centres of ISRO/DOS took upon themselves the development of digital image analysis systems, with the active involvement of the industry. While the expertise in ISRO/DOS was in the image analysis, specifically for the remote sensing data, the expertise in the computer systems and data/signal processing at the Indian industry was primarily responsible for the overwhelming success in developing indigenous image analysis systems. Despite stiff competition from the overseas vendors, the PC-based Stand-alone Image Analysis System was introduced in the market in a remarkably short time, reflecting the intense joint efforts by ISRO/DOS and industry. This system is comparable to the most preferred systems of this category in the global market, both in terms of performance and price.

The digital image analysis systems based on ISRO/DOS technologies presently available from the Indian industry in the market are as follows:

Interactive Intelligent Image Graphics Display Terminal.

- Microprocessor-based Multispectral Interactive Data Analysis System
- 80386 PC-based image analysis systems, viz., ISROVISION with SACIMAGE & VIBGYOR-2001 (Figure 3)
- Satellite Image Processing System (Figure 4)
- Middle End Image Analysis System with ISROVISION/SIPS as workstations (Figure 5)
- Frame Grabber (Figure 6)
- Colour Photowrite System
- Drum Scanner/Digitiser



Figure 3. ISROVISION with SACIMAGE and VIBGYOR - 200.

In developing the digital image processing systems, ISRO/DOS have been far-sighted to see that the trend would be to move away from proprietary operating systems. Hence the choice of ZENIX for



Figure 4. Satellite Image Processing System (SIPS)



Figure 5. Middle end Image Analysis System with ISROVISION/SIPS as workstations.



Figure 6. Frame Grabber.

the PC-based systems and later UNIX for the higher level systems has been vindicated. Further, the choice of the 386-PC platform bypassing the 286-based platform, was also a judicious choice enabling very smooth migration to the 486-based systems, thus presenting significant processing power at the fingertip of the user.

The RS technologies transferred from ISRO/NRSA to Indian industries during the period 1981-90 are illustrated in Figure 7.

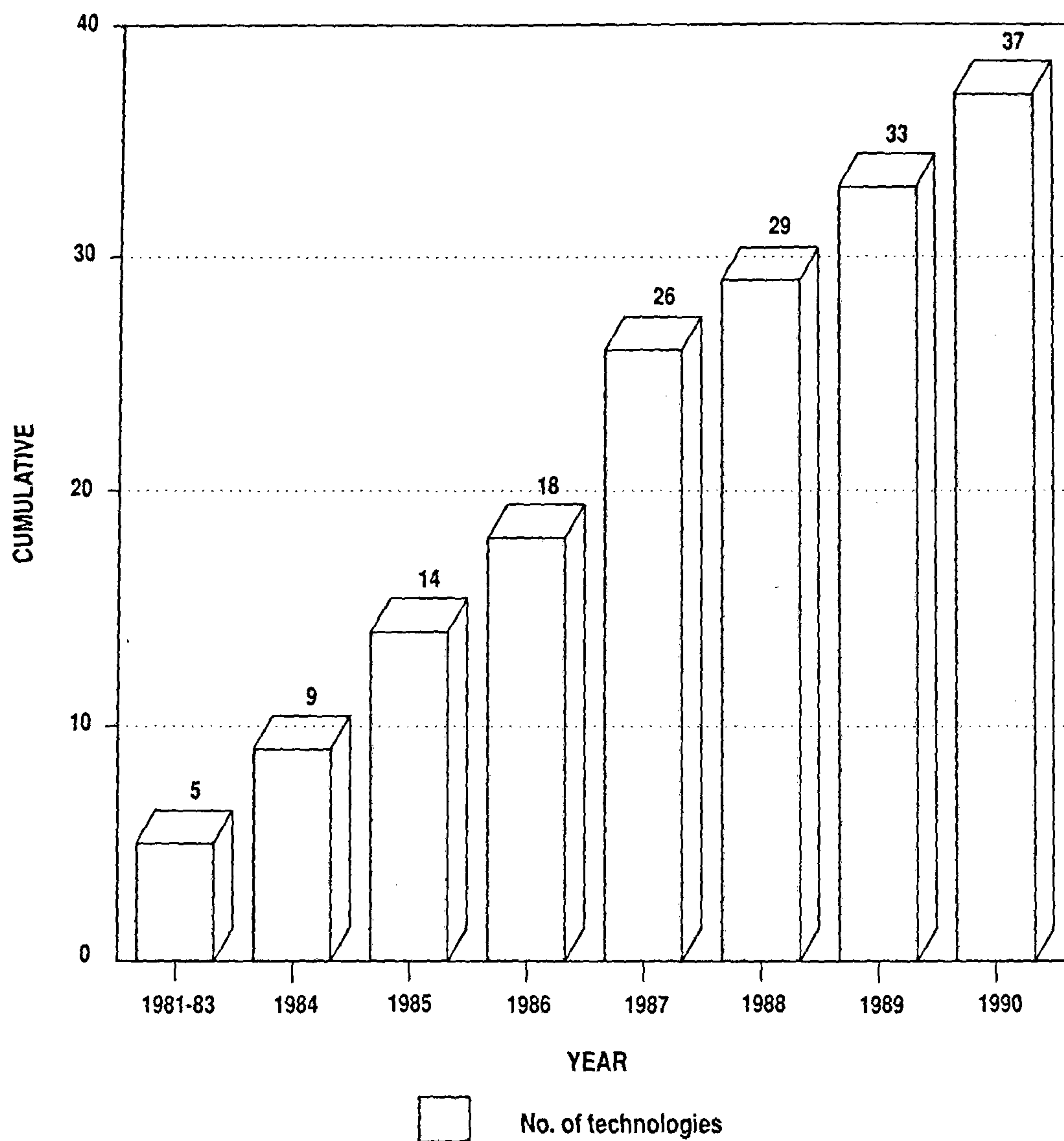


Figure 7 . Remote sensing technologies transferred from ISRO/NRSA to Indian industries

ROLE OF THE INDUSTRY

All these products are now available from the Indian industry for catering to the user organisations. The role played by the industry in taking up the production of these prototype models from ISRO/DOS, and also developing the market in record time has been commendable. The timely intervention to develop these products and transfer them to industry has helped in not only saving a substantial foreign exchange, but has also provided the scientists involved, an easy and inexpensive access to the remote sensing technology and its early induction into operationalisation. The credit for this goes to the enterprising industry, which did not go after imported technologies.

Another major effort, the industry had to undertake in the initial stages was to promote the growth of the newly established remote sensing applications market. Most of the industries which entered this area were belonging to small scale sector. Realising the possible problems beyond the control of individual unit with respect to market promotion, maintenance support, etc. they formed a Federation of Remote Sensing Companies in India (FORSCI) with active support from ISRO/DOS. This forum is also providing export promotion, joint R&D, etc.

FUTURE PRODUCTS

While the past has been quite gratifying in terms of

the efforts leading to fruition, it is recognised that there is a need to continuously update the products/systems and also to take up more advanced and complex systems to cater to the increasing demands from the user agencies and also to satisfy a larger market, emerging from the successful utilisation of the remote sensing techniques in many areas/disciplines. The Centres of ISRO/DOS have been pursuing this task rigorously, and the following are some of the systems/products under development:

- Portable Band Ratioing Meter.
- Point Light Source Contact Printer.
- Precision Coordinate Measuring System.
- Stereo-Optical Transferoscope.
- Geographic Information System.
- Transputer-based Image Analysis Systems.

CONCLUSIONS

The touchstone of any R&D effort is its culmination into products/systems acceptable to the users/market. In the area of remote sensing, the successful transformation of the developmental efforts into systems has had a gratifying effect to the scientists and engineers of ISRO/DOS. The confidence placed by the industry in the ISRO/DOS technologies has been commendable, and it is the mutual trust that has been solely responsible for the present state of satisfaction.

