2.13 Technician Training and Instrument Production in India: The Experience of CSIO

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Realising the importance of instrumentation as a national activity, the Council of Scientific and Industrial Research established the Central Scientific Instrument Organisation (CSIO) in 1959 at India's newly planned city of Chandigarh. The aims and objectives of the CSIO were to train instrument engineers, to undertake the repair and maintenance of all scientific/ medical instruments available at the educational institutions and hospitals in India and to develop the design and production of education/scientific/medical instruments.

The first activity to start at Chandigarh was the establishment of the 'Indo-Swiss Training Centre' (ISTC) in technical collaboration with the Government of Switzerland (Swiss Foundation). At ISTC a three-year diploma course for boys is conducted. During the training period students are trained extensively in theory and practicals covering all aspects of instrumentation (optical, electrical, electronic, geoscientific, medical, etc) technology, including workshop and foundry practice. This course is based on the Swiss pattern of training technicians. The minimum qualification for undertaking the course is passing the school final examination. The ISTC diploma is highly regarded, both in Government establishments and in industry. About 70 students are admitted after strict aptitude and general knowledge tests in technical and science subjects, followed by an interview. Nearly 5000 students apply for the course every year. In addition, ISTC conducts one-year post-diploma courses in industrial electronics and in die and mould. The annual intake for the post-diploma courses is around 30 students. Over the past nearly three decades ISTC has trained more than 1300 instrument engineers who are contributing substantially to the instruments industry in India.

In view of the large size of the country and the distribution of educational institutions, hospitals and industries, CSIO had set up nine well equipped Service and Maintenance Centres (S & M Centres) all over India. With trained manpower available at these centres, CSIO has achieved great success. The repair work done at the S & M Centres is at a subsidised cost, recovering practically only the cost of components plus small handling charges. At some places the centres take total responsibility for the maintenance of equipment on an annual contract basis. In most developing countries, large numbers of imported instruments are not in working condition owing to the non-availability of spare parts and after-sales service. In addition, the world instrument industry is undergoing a major technological change with the advent of micro-processor based instruments, resulting in a rapid rate of obsolescence; as a result, leading world instrument manufacturers are unable to supply spare parts after a few years of manufacture. Developing countries also often lack funds for spare parts and maintenance. CSIO, therefore, encourages its S & M Centres to undertake modifications/adaptions of customers' equipment, using local expertise to keep down-time at a low level. Using the CSIO model, practically all universities in India have started a University Service and maintenance Instruments Centre (USIC).

In addition, the Government of India has set up more than nine Regional Sophisticated Instruments Centres (RSIC) all over the country, where costly analytical instruments are available for use by the staff of universities and industries. These RSICs conduct seminars, workshops and training programmes for the users. CSIO staff play an advisory role in various activities of the USIC and RSIC.

Right from the beginning, optics (and optics related work) has been a major thrust area at CSIO. Today, it is India's leading centre for doing work in optics of international standard. In geometrical optics it has generated substantial capability in lens design and manufacture and, based on the knowledge generated at CSIO, a major optical industry has been set up in the Ambala-Roorkee area of India. Through these industries the country's requirements for surveying instruments, for education and engineering and for microscopes and microscopic optics for hospitals and research are fully met by indigenous production. Some of these industries have also fulfilled export orders. CSIO has a modern optics shop with facilities for curve generation, optical grinding, polishing, lapping, coating (single and multiple layers), etc. For the past ten years, scientists at CSIO have been engaged in diffraction - limited optics, including space optics. CSIO has set up modern facilities for holography. Large size high-efficiency holograms (white light, rainbow, etc.) are produced in the laboratory. Some original work done at the holography laboratory has been published in international journals. CSIO has a major programme on short-haul applications of fibre optics. Under this programme, CSIO has successfully designed and built a ten-line telephone system for a colliery in Bihar. This is the first telephone system ever to be installed in a coal mine in India. The optical fibre for this was drawn at the Central Glass Ceramic Research Institute, Calcutta and the work was coordinated by the Central Mine Research Station, Dhanbad. CSIO has also produced and supplied optical-fibre educational Kits-MODEMS. On the medical side, efforts have been successfully made to produce LYPROSCOPE for the family planning programme. CSIO has established a full characterisation facility for assessing the quality of an optical fibre; under this programme the refractive index profile, attenuation and spectral characterisation of any optical fibre can be measured at an Echelon III level.

Under the auspices of the Department of Science and Technology, and in collaboration with the Indian instrument industries, CSIO undertook a three-year intensive programme of development of several analytical, geoscientific and agri-electronics instruments. Three major analytical instruments were developed: a low-cost short-column scanning electron microscope (SEM) with 75 Å resolution and 80,000 magnification was developed with clean vacuum suitable for biomedical and material science applications: secondly, a micro-processor based Atomic Absorption Spectrophotometer (AAS) with dual lamps was developed: thirdly, a micro-processor based, dual beam UV-Visible Spectrophotometer was completed. All three instruments are now in commercial production in India. In the geoscientific area, batch production of analog seismographs with drum and chart was developed. Batch production of digital cassette seismographs using C-MOS technology along with cassette readers was also developed. Both these instruments are of stand-alone type and are used in remote terrain for the measurement of micro-tremors and earthquakes. Since India is a largely agricultural country, many field-usable agri-electronics instruments will be required, mainly to measure the quality and constituents of soil, if scientific methods are to be employed to obtain greater yields of grain per hectare from the land.

CSIO developed and manufactured field-usable instant pH-meters, soil, salinity testers and soil analysers. These and other agri-instruments, such as grain moisture measuring instruments, are manufactured by Indian industries.

In collaboration with the Society for Applied Microwave Electronic Engineering Research (SAMEER) and the post-graduate Institute of Medical Research and Education in Chandigarh (PGI), CSIO developed a modern 4 million volt Linear Accelerator (LINAC) for the treatment of cancer patients. This project was supported by the Department of Electronics of the Government of India. The LINAC is now operational at PGI hospital, treating about 40 patients every day for the past year or so. A consortium of Indian industries will manufacture 4 MV LINACs to provide facilities to treat cancer patients, whose number has increased considerably in the past few years.

Another important project undertaken at CSIO is the development (and limited production) of a Scanning Tunnelling Microscope (SEM) with atomic resolution as a joint project with the Naval Research Laboratory of USA under the INDO-US programme. A SEM capable of operating in air is already undergoing final trials; in the second phase, an SEM capable of operating under ultra-high vacuum conditions will be developed. CSIO has a major programme of development of sensors for robotic operation, supported by the Department of Electronics; tactile and vision sensors are in an advanced stage of development. CSIO is presently executing an UNDP project on the development of a set of micro-electronics instruments required for producing very large scale integrated circuits (VLSI) in the 1-2 micron range, viz. optical stepper for optical lithography (I line), high current ion-inplanter, molecular beam epitaxy system (MBE), reactive ion beam etching systems, radio frequency/DC sputtering unit, electron beam evaporator and VLSI tester. CSIO has also developed a set of physics-based equipment for pollution monitoring, including automobile exhausts, and undertakes to manufacture special equipment for the Indian Navy and Air Force.

From the above, it is quite evident that CSIO has fully met its objectives. CSIO also provides a resource centre for Indian industries and other establishments. It publishes a 'Directory of Scientific Instruments and Components' as well as a house journal ('CSIO Communications') and has a fairly large library, computer centre, well equipped machine shop, foundry and metallurgical laboratory, documentation services and hostels for ISTC students, all housed on spacious land with thousands of trees. CSIO accepts engineering students from various universities for summer/practical training; many students are offered a stipend by the CSIO. National seminars/symposia/workshops are regularly held by the CSIO.

CSIO's experience could be utilised in other developing countries. Through international bodies like UNDP, UNIDO, WHO, etc., CSIO undertakes training programmes for members of other developing countries. The lack of skilled manpower and inadequate industrial infrastructure are some of the major constraints in undertaking high quality research work in the developing world. Developed nations can guide and provide training programmes, which could be conducted in the developing countries at considerably reduced costs; India could be considered as a suitable venue.

The Author

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