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REVIEW

FINANCING TECHNOLOGY DEVELOPMENT AND COMMERCIALIZATION - THE ICICI EXPERIENCE

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INTRODUCTION

ICICI - A Development Bank with a Difference

The Industrial Credit and Investment Corporation of India Limited (ICICI) is a Development Finance Institution (DFI) set up in 1955 with the assistance of the World Bank, to encourage and assist industrial development and investment in India. Its objectives, *inter alia,* include providing assistance in the creation, expansion and modernization of industrial enterprises, encouraging and promoting participation of private capital, both internal and external, in such enterprises, encouraging and promoting industrial investment and helping the development of capital markets.

Project finance

Project financing has been ICICI's principal line of business. For project financing, ICICI endeavours to evolve products tailored to meet the varied requirements of Indian industry's capital investment programmes. As a development bank, ICICI counsels new entrepreneurs at an early stage and offers advice to existing entrepreneurs on optimizing the finance-mix to work out options ideally suited for their requirements. Some of the forms of assistance are :

- Long-term rupee and foreign currency loans.
- Margin money for working capital.
- Direct subscription to and underwriting of shares and debentures.
- Guaranteeing payment to suppliers of equipment.
- Soft funding of projects located in backward and growth areas and infrastructure development and modernization.
- Funding of exports, including grants for productivity improvement.
- Lines of credit to manufacturers as well as buyers of capital goods.

Innovation has been a tradition in ICICI and apart from providing project finance, it has pioneered and achieved leadership in diverse fields from merchant banking to technology development and commercialization. Some of these activities which make ICICI different from other institutions are :

Merchant Banking and Leasing

Close association with industry, often reaching beyond the role of lender or financier, has provided ICICI with an insight into industry's problems. Realizing the need for organized merchant banking services for its clientele, ICICI started its Merchant Banking Division (MBD) in 1973. ICICI's MBD has unrivalled reputation not only quantitatively in terms of the number and size of assignments handled, but for the quality of its service. The Division owes its pre-eminence largely to its appreciation of the requirements of its clientele and its innovative problem-solving approach. The major MBD products are - Management of capital issue, Syndication of long-term rupee and foreign currency finance, Mergers and amalgamation, Financial restructuring, Financial consulting services, Feasibility studies and Short-term fund syndication. Since 1973, the Merchant Banking Division has assisted clients to raise a total amount of Rs. 194 billion including Rs.130 billion from the capital market.

Growth in volume and complexity of business and sophistication in financial management techniques in India especially during the 1980s, generated a demand for new financial instruments. ICICI was the first financial institution to establish leasing as a financial product. A fledgling unit in 1983, ICICI's Leasing Division is an industry leader today. As of March 1992, total approvals under leasing have been for Rs. 84.2 billion.

Export Development

Realizing the importance of exports, ICICI has made considerable efforts in assisting Indian companies in their export development programmes. Since 1986, ICICI has been providing special assistance to Indian exporters by way of term loans and grants under two lines of credit mobilized from the World Bank - Export Projects I & II.

ICICI has provided foreign currency loans of US $ 300 million to over 250 export-oriented projects under the World Bank Export Project. In addition to this, under the Productivity Fund grant, finance of US $ 10 million has been provided to 150 export development programmes. For the export development programmes, ICICI has evolved the following services:

- The Export Development Fund (EDF) which provides grant finance of up to 50 per cent of the expenditure in developing and implementing a strategic export development programme. The programme can be related to manufacturing operations including productivity improvement and/or export marketing.

- Export Advisory Service for development and implementation of long-term export strategies.

Export Breakthrough Service in collaboration with DECTA, a British Trade Development Agency based in London. This service provides advice and grants finance for overseas market research in the target countries.

Project Advisory Services

Aimed mainly at foreign investors interested in undertaking project investments in India, ICICI acts as a focal point to enable them to forge relationships with Indian industry. This could be in the form of a technology tie-up, joint venture with an Indian partner or an independent project investment. The range of services offered provides a 'turnkey solution' to foreign investors by handling all preliminary arrangements prior to setting up of a project. This includes - preparing industry perspectives, identifying/evaluating joint venture partner(s), undertaking market studies, obtaining statutory approvals, arranging legal advice and arranging recruitment services.

Technology Finance

In the performance of its primary function of providing development finance to Indian industry, ICICI has constantly endeavoured to evolve new schemes especially to bridge the technology gap. To become, and remain internationally competitive from the technology angle, industries require funds for R & D and technology development, for product and process innovations as well as for productivity improvements and technology upgradation. ICICI has designed new ways of financing the varying needs of Indian industry covering the entire spectrum of R & D activities from prefeasibility and laboratory studies to pilot plant and scale-up operations leading to eventual commercialization. These include:

1. The Programme for Advancement of Commercial Technology (PACT), with the United States Agency for International Development (USAID), under which ICICI administers a fund of $ 15.5 million for financing joint Indo-American R & D projects for the development of innovative products and processes.

2. Programme for Acceleration of Commercial Energy Research (PACER), an innovative project to encourage consortium and contract research in energy sector including conservation, funded by USAID with a grant of US $ 20 million, executed by ICICI under the direction of Department of Non-conventional Energy Sources (DNES).

3. The Sponsored Research and Development (SPREAD) Programme, designed to encourage industrial firms to step up their R & D activities by sponsoring projects with technology institutions. The programme with a funding of US $ 15 million by the World Bank envisages cooperation between industrial firms and technology institutions in the country so that R & D projects are implemented in a cost effective manner.

4. The Technology Institutions (TI) Programme, for strengthening the capacity of selected technology institutions for accelerated development of indigenous technologies. The TI programme with a funding of US $ 40 million from the World Bank helps the institutions to upgrade their facilities and enhance their expertise so that the R & D needs of the industry are served more effectively.

5. Agricultural Commercialization and Enterprise (ACE) Programme, managed by ICICI for supporting investment in horticulture, focusing on post-farm operations including : handling, transport, cold storage, processing, packaging and marketing with a funding of US $ 20 million from USAID. It also involves technical assistance in the state-of-the-art technology, management and marketing information.

6. Trade in Environmental Services and Technology (TEST), is a new programme with a fund of U.S. $ 25 million from the United States Agency for International Development being implemented by ICICI with a view of enhancing the productivity of Indian industry on a sustainable basis by adapting cleaner technologies. The programme would finance activities that aim at increasing environmental protection by adaptation of state-of-the-art technologies.

7. Centre for Technology Development (CTD), a society with broad objectives of technology development, promotion of R & D, assistance to scientific research institutions, promotion of venture capital, human resource development and technology information exchanges.

8. A venture financing progamme for commercialization of high-technology projects through the Technology Development and Information Company of India Limited.

Details of these programmes on technology financing and commercialization are provided later.

Other Services

The very concept of development banking has been enlarged by ICICI. It has identified, over the years, many of the requirements of the financial infrastructure of the country and promoted organizations to fulfil these needs. Among the innovative institutions set up by ICICI are :

- Indian Investment Centre, New Delhi.
- Institute for Financial Management and Research, Madras.
- Housing Development Finance Corporation Limited, Bombay.
- Indian Institute for Foremen Training, Kansbahal.
- Credit Rating and Information Service Company of India Limited, Bombay.

- The Shipping Credit and Investment Company of India Limited, Bombay.
- Technology Development and Information Company of India Limited, Bangalore.
- Academy for Management Excellence, Madras.
- Over The Counter Exchange of India.

Organization

ICICI has a Board of Directors comprising persons of eminence from industry, government and the professions. The management team, is ably supported by inter-disciplinary professionals (about 400) - engineers, finance and management experts, economists, lawyers and chartered accountants. The organization of ICICI is characterized by a high degree of professionalism, effective delegation of authority and decentralization, computerized database and accounting procedures and a swift communications network for effective client-servicing. ICICI's total staff strength is about 1,000 persons. With a Head Office in Bombay, it has regional offices in Calcutta, Delhi and Madras and Branch Offices in Baroda and Bangalore.

Operations

ICICI is considered to be one of the most successful Development Banks in the World. ICICI operates at the national level and has assisted about 4200 companies for 9900 projects relating to agribusiness, petrochemicals, fertilizers, steel, cement, textiles, chemicals, automobiles, machine tools, electronics and electrical products. As of March 31, 1992 ICICI's share capital amounted to Rs 17.1 billion and reserves Rs 72.5 billion. ICICI's cumulative sanctions up to March 31, 1992 amounted to Rs 238 billion. During 1991 - 1992 its sanctions amounted to Rs 43 billion and with an income of Rs 11 billion. ICICI had a net profit of Rs 2 billion in 1991 - 1992 and declared a dividend of 24% for its shareholders - now numbering close to half million.

Sharing Experience

ICICI has from time to time been sharing its experience through training, conferences and seminars, industry studies and publications. Since 1979, ICICI has been offering consultancy services to overseas development finance institutions for upgrading their procedures and operations. Such institutional assistance has been provided to development banks in Bhutan, Ghana, Jamaica, Nepal, Sri Lanka and Uganda.

TECHNOLOGY FINANCING

It is a well known fact that the developing countries spend much less on Research and Development than do the industrial ones. India is no exception. Latest available data indicate that the amount spent on Research and Development in India was 0.89% of

GNP. Some of the developed countries are spending 2% - 3% of their GNP on R & D. Further, India's per capita R & D expenditure is only US $ 3 as against US $ 100 - 600 for most of the developed countries.

Research and Development may have a very long pay - off time and also requires high levels of education and skills. A developing country has many demands on its resources. Most of the resources are spent on immediate consumption and development of industry to harness the local resources. Also, many of the products that the country needs are available from abroad or could be manufactured with borrowed technology. Hence, development of indigenous research and development occupies a secondary place in the order of priorities of a developing country.

In spite of these factors, development of indigenous know-how is essential ; firstly the new process and products available from other countries may not be always suitable for a developing country. Secondly the consumer tastes, preferences and requirements are often different. The labour saving technologies developed in countries with scarce and costly labour are not relevant to developing countries where unemployment is a major problem. Moreover, there is also an obsolescence factor involved in importing technologies, since by the time projects based on these technologies commence production, the technologies are already about ten years old. In addition, technologies being developed by industrial nations in high-tech areas of space, super conductivity and artificial intelligence are not of much use to developing countries where basic needs are to be met in the first instance. What is required in such circumstances is development of appropriate technology - as per the local needs and available resources.

Countries borrow technology from each other. However, in order to learn from borrowed technology and build on it, simultaneously a technological infrastructure has to be created. Japan's achievements in this regard are commendable. Starting with technology acquisition in the first instance, then adaptation, modification and finally adding-on its innovations, Japan has reached the highest level of technology achievements in many fields. Japan was able to do so by purposefully planning to create an excellent technological base.

India is among the few developing countries which realized the importance of indigenous research and development and set-up elaborate infrastructure through national laboratories, institutes of technologies, institutes of science etc. However, most of these institutions either have been established directly by the government or public sector undertakings. Their attention has been more towards scientific research than industry related/market oriented technology development. Out of the total R & D outlay in India of Rs. 418 billion, the central government accounted for 69%, public sector companies 11%, state governments 8% and private industry 12%. The total R & D expenditure by industrial sector was Rs. 97 billion in 1990-91. Industry

spends about 0.66% of its sales turnover on its R & D activities. The corresponding value for many of the developed countries is 3% - 4%.

The experience of newly industrialized countries shows that the technology investment should be led by private enterprise and the development carried out on a voluntary basis. When this happens, technology development is closely linked to the market needs and results in development of small, practical technologies that are commercialized quickly. It is also necessary that the investment in technology development is made uniformly through all sizes of industry - small, medium and large. It is therefore necessary that the private sector in the country devotes its resources to research and technology development. In this connection, it may be mentioned that within one decade (1961-1970), research and development expenditure in private sector in Japan increased five-fold, while over the same period the Gross National Product (GNP) increased only 3.8 times. In Japan, the investment by private industry is 2 1/2 times that of the government.

ICICI, considering the importance of R & D in the industrial development of the country, way back in 1970, called a "*Conference on R & D in Industry*" to focus attention on the development of indigenous technologies and setting up of R & D centres by the private sector companies. The conference also discussed incentives that may be provided by the government to motivate industrial units to setup R & D centres. Today, there are about 250 specialized institutions and research laboratories set-up by different science and technology departments and other agencies of the government. There are also about 1200 in-house R & D units set-up by the industry, in both the private and public sectors. ICICI provided financial assistance to some of the units in the private sector. Apart from in-house R & D centres, ICICI also financed some independent units for undertaking commercial R & D work.

In the mid seventies, ICICI set-up the Development Department with a view of supporting activities relating to entrepreneurship development with emphasis on technical entrepreneurs. Jointly with other institutions it has financed 1250 *Entrepreneurship Development Programmes (EDP)* in various parts of the country. Of these programmes 240 EDP's were specially tailored for *Science and Technology Graduates*. ICICI's share for entrepreneurship development amounts to Rs. 28 million.

ICICI also participated in setting up 17 *Technology Consultancy Organizations (TCO)* in different states to provide consultancy services to medium and small scale enterprises. ICICI's assistance to various TCOs amounts to Rs. 11 million in the form of equity capital and loans. TCOs have provided valuable services to entrepreneurs in the preparation of project feasibility studies, industrial potential surveys, special studies on development of industrial estates, engineering designs etc. ICICI has been

the lead institution for TCOs in three states. The working of ICICI led TCOs is both satisfactory and profitable.

ICICI also assisted several non-governmental organizations engaged in rural development to improve the skills and employment potential of rural population and *development and adaptation of rural technologies.* Forty two diversified schemes ranging from a polytechnic for rural women to mobile education programme on environment protection in rural areas have received a total assistance of Rs. 22 million from ICICI. Some schemes are meant to assist blind and other physically handicapped persons to acquire technical skills for gainful employment.

ICICI has also provided assistance in setting up *Science and Technology Entrepreneurs Parks (STEP)* in seven states. These parks provide opportunities to new technical graduates to channel their knowledge into setting up an industry thus resulting in self-employment. These parks endeavour to increase interaction between technical institutions and industrial enterprise. STEPS provide a productive and innovative environment with the necessary infrastructure for budding entrepreneurs to experiment with their innovative ideas. Recently, ICICI has also planned to finance a scheme for setting-up *Incubators* where young technical persons would receive hands-on support relating to technology, management and marketing. These incubators are to nurture enterprises in the initial stage.

Arising out of the ICICI's experience of supporting technology development, USAID offered help to the ICICI to implement a scheme termed the "*Program for Advancement of Commercial Technology*" - *PACT* which relates to the financing of joint ventures for development of technologies with commercial potential.

PROGRAMME FOR ADVANCEMENT OF COMMERCIAL TECHNOLOGY (PACT)

PACT has several innovative features. Instead of transferring knowledge, it develops knowledge jointly between Indian and U.S. firms. This is done for technologies that have immediate prospects of commercialization. PACT involves development of innovative products or process. Another featu re of the scheme is that assistance is provided in the form of *Conditional Grants,* which means that in case of failure at the development or commercialization stage, the assistance could be written-off. Thus a major constraint in developing innovative technologies viz. what to do in case of failure, is taken care of. Anxiety regarding timely payment of interest on a quarterly basis during the developmental stage and instalment payment of commercialization, in case of failure, is removed. It is stipulated that, on successful commercialization of technology, a royalty on sales would be paid back to the PACT fund till the amount reaches a level of two and half times the original grant.

Design of the PACT program provides for the acceleration of the pace and quality of technological innovations for products and processes having applications in industry, agriculture, health, energy and other areas beneficial to the development process in India. The focus on the "*Development End*" of R & D means that substantial savings in cost, time and risks in carrying out commercially successful innovations. The primary thrust is on market oriented R & D activities, aimed at India's technological advancement.

Since PACT envisages technological development (not just technology transfer) through joint ventures in R & D, it means introduction of new ideas and an opportunity for the Indian partner to acquire R & D management techniques.

Details of the PACT programme are given below:

Nature and scope of cooperation

On account of the diverse projects and joint venture that may qualify for PACT support, there are no specific rules for the detailed nature of the cooperation between partners. They are expected to reach an understanding regarding the division of activities in order to achieve the technical and commercial goals of the project. For example, if the bulk of the R & D is to be performed by one partner (typically in India), the contribution of the other partner may emphasize marketing and detailed product specifications, sales, service, etc. and joint supervision of the R & D effort. Manufacturing may be by either or both partners, or by subcontractors, or by their licensees. Institutions or non-manufacturing companies may act as subcontractors in the R & D or testing phases of the project.

Eligible Projects

Following types of projects are eligible for PACT assistance viz. those that

(a) involve the development, through R & D, of an innovative product or process which promises tangible direct benefits for the Indian economy;

(b) envisage financial exposure and projected returns from commercialization which are commensurate with the risks;

(c) are proposed by an Indian company and US company as a team, with each member having a specified role and capability in the development and commercialization;

(d) involve a project cost typically not exceeding $ 1 million;

(e) envisage a PACT contribution up to $ 500,000;

(f) have capability of significant commercial potential;

(g) are capable of completion within a period of three years;

(h) not related to defence/armament, surveillance, weather modification or abortion related equipment and services.

Eligible Applicants

The clearest case of an eligible applicant is typically a company having access to R & D and manufacturing facilities and a demonstrated capability in selling its product, developed in response to specifically identified market needs or opportunities. Eligible applicants, one from each country, apply as a team on the basis of an agreement that permits them to obligate themselves singly and jointly in a contract with ICICI for the project. Participants based either in India or the US, approach ICICI with the expectation of receiving assistance in finding suitable partners in the other country.

ICICI endeavours to assist innovations originating with individual entrepreneurs or new companies which may otherwise have difficulty in the development stages of research and development.

Form of Assistance and Scale of Financing

The financial assistance envisaged is typically in the form of a *Conditional Grant* which is beneficial and practical to operate for all the parties concerned and specifically relevant to the ends in view.

Any pair or operating entities, one each from India and the US submit a *Proposal* for joint development and commercialization of any innovative technology based product or process that has the potential of yielding returns commensurate with the investment and risk. If the proposal is convincing in the context of the proposing team, PACT typically shares 50:50 with each of the participants in the total cost of bringing the proposed product or process to the point of commercialization readiness. The PACT assistance is normally limited to $500,000 or 50% of the total estimated cost, whichever is less.

Based on the amount and nature of expenditure, financial assistance is provided for:

(a) project proposals; and
(b) prefeasibility expenses.

(a) Project proposals

Project proposals are submitted to the ICICI, PACT Division and scrutinized using a two-tier evaluation process. The proposal is initially reviewed by the PACT Division and technical specialists from a particular skill area. Thereafter, initially acceptable/qualifying projects are placed before the decision-making body for approval. On approval by the Screening Committee, a cooperation and financing agreement is entered into by the proposer and ICICI. This agreement will describe the work plan, project budget, payments due to the proposer, payments due from the proposer, from sales or other income resulting from the project, reporting requirements, preconditions for disbursements such as satisfactory progress and a continuing good market forecast for the proposed product/process.

Project expenditure includes salaries and wages, materials and utilities, cost of consulting, services, subcontracts and data processing, necessary travel and administrative expenses, outlays to meet regulatory requirements, pre-marketing expenses, special purpose equipment but not standard catalogue equipment and facilities used for production purposes which the proposer is expected to own or provide.

Normally expenditure incurred prior to the effective date of the cooperation and financing agreement is not included in the project cost.

(b) Prefeasibility Expenses

In cases where preliminary investigations are necessary to determine the technical prefeasibility or market acceptability of a new product or process or where two potential participants are confronted with considerable expenses in preparing a proposal by nature of the need to visit each other specifically and such expenditure is likely to be burdensome at that stage, ICICI grants up to $25,000 as 50% of PACT share of the cost of carrying out the feasibility study. Such approvals are made on an understanding that a formal proposal will be submitted by the proposer for consideration if the feasibility tests are positive. Should this effort lead to a PACT supported project, the amount provided for the prefeasibility expense is added to the conditional grant for the project.

If such a prefeasibility study suggests a viable project which the participants choose to abandon or discontinue, the participant will be obliged to refund the full amount of the prefeasibility grant.

Disbursement of Conditional Grant

Conditional grants approved under PACT are disbursed to proposers on the basis of their needs and in mutual consultation with them. A first disbursement of up to 40%

of the amount approved is considered on signing the agreement while the balance amount is disbursed on the basis of technical and fiscal reports. If the work completed on a project is unsatisfactory, ICICI reviews the project with the proposers and determines a suitable course of action with respect to further payments against the conditional grant, if any.

Payments to ICICI by Proposer

The PACT shares typically 50% of the total project cost, in the form of a conditional grant (in dollars and/or rupees) connoting that:

(a) The proposer agrees to make payments to ICICI at a negotiated percentage of revenues arising from the project on commercialization;

(b) Such negotiated payments are limited to a maximum of 200 per cent of the PACT share in the project; and

(c) ICICI assumes its share of risk, no revenues-no payments.

Project Proposal Evaluation Criteria

Listed below are the indicative criteria for evaluating project proposals for PACT assistance:

(a) The nature and degree of technological innovation of the product/process;

(b) The extent of benefits accruing to the partnership;

(c) The prospects for commercialization based on clear definition of the market;

(d) A satisfactory return on capital employed;

(e) Proven strength of the participants in terms of availability of financial resources, marketing capability, manufacturing capability, technology base and skills;

(f) Special factors that merit consideration, such as regulatory legislation, energy conservation and location; and

(g) The extent of the catalytic effect if the project is a success and the impact on goals of PACT.

Technical Evaluation of Project Proposals

Technical evaluation of project proposals is carried out by ICICI as appropriate with the assistance of Industry experts/consultants (India/US).

In evaluating a proposal consideration is given to the extension of the state of the art in relation to other products and processes that have been developed by the participants and by other enterprises. The innovation must be technically credible. Initial feasibility must justify incremental investment for significant commercial returns. Activity schedules and benchmarks necessary to attain project goals are evaluated.

PACT - Achievements

PACT program began in late 1986 with an initial fund of U.S. $ 10 million from USAID under an agreement with the Government of India. The fund was subsequently increased to U.S. $ 15.5 million in 1990.

Until the present time, about 37 projects with an aggregate assistance of U.S. $ 14 million have been approved by ICICI. The major areas covered by the projects are information technology, software development, biotechnology, energy, engineering, environment, health care and pharmaceuticals. Of these, 8 projects have commenced reflows to the PACT fund on commercialization, 9 projects have completed the development phase and are about to start commercialization, 8 projects have made substantial progress, 5 are mid-way, 9 projects have commenced implementation recently and 2 have been discontinued.

Some of the impact making projects under PACT are development of a process package for high yielding prime button mushrooms using Indian compost and raw materials and export of hybrid strains, a permanent magnet alternator with electronic controls for mobile applications, a component library management system and component data base which enables electronic designers to select the best available device reducing cost and time-to-market, bio-pesticides, birth control devices, a computer aided garment production system, bio-drugs for Parkinson's disease and an infection free catheter system for post-operative health care.

Two independent evaluations of PACT programme have been made. One by a team of consultants appointed by USAID and second by the well-known international consultancy firm Price-Waterhouse. The team also included the Director for Bi-National Industrial Research and Development (BIRD) Foundation, Israel a country which has a programme similar to PACT. The evaluation reports confirm that PACT has substantially fulfilled its objectives and given a fillip to commercial R & D activities in the country. It has also demonstrated the benefits that could flow to both the countries arising out of fruitful partnerships. It may be mentioned that 19 projects under PACT would cater to the markets in the USA in the fields of software and biotechnology and generate revenue of about U.S. $ 40 million in 1992-95. Other projects would cater to the markets in India in the fields of energy, environment and biotechnology, generating a revenue of U.S. $ 20 million. Some of the start-up

companies under PACT have established important partnerships and other links with large U.S. firms. Links have been established with Mentor Graphics, Hewlett Packard, Hughes, Tektronix and NCR as customers and Net-work General as strategic partners. PACT has 10 proposals and 27 profiles under formulation. It has received 12 new profiles. A large number of projects would cater to the niche markets in USA and provide an advantage to U.S. companies to compete in the international market. Some of the PACT projects create additional employment and revenues to both the Governments. PACT has helped the export earnings of India.

Significantly there have been no major failures under the PACT Programme. It is considered to be one of the most successful programmes in the world undertaken by USAID. A very important contribution of the programme has been to trigger off the venture capital movement in India and ICICI's further involvement in technology finance through other innovative schemes like Programme for Advancement of Commercial Energy Research (PACER), Sponsored Research and Development (SPREAD), Technology Institutions Program (TIP), Centre for Technology Development (CTD), Agriculture Commercialization and Enterprise (ACE) and the latest Trade in Environmental Services and Technology (TEXT). Each of these programs have been innovative in the Indian Context. Salient features of these schemes are discussed below.

PROGRAM FOR ACCELERATION OF COMMERCIAL ENERGY RESEARCH (PACER)

PACER programme supports technology innovation and development in the Indian energy sector. It is being implemented by ICICI and the Department of Non-Conventional Energy Sources (DNES), Government of India.

PACER aims at promoting development of goal-oriented and market responsive technological innovations in the Indian energy sector through financial assistance to a consortia of manufacturer(s), research institution(s) and/or end-user(s) from the public and private sectors in India.

PACER provides promotional assistance and finance in the form of a conditional grant for meeting part of the project cost which absorbs some risk inherent in technology development. Liability for payment towards the conditional grant arises when the technology is commercialized. In addition, PACER provides grants for pursuing research in support of technology development projects.

It is envisaged that proposers for projects to be financed under PACER will normally be India. However, in cases where US participation is necessary in technology development efforts, suitable provision could be made for the purpose.

Priority Areas

PACER's thrust is mainly on the development of innovative products and/or processes for the officially identified priority areas of the Indian energy sector. For example, the Five Year Plan documents include acceleration of exploration of coal and hydropower resources, intensification of exploration of oil and gas, energy conservation and exploitation of renewable energy resources as the priority areas. Keeping these in view, an illustrative list of some technologies has been prepared.

Commercially attractive technologies to tap biomass or solar energy:

- biomass fired power units
- wind and photovoltaics
- small-scale hydro electric generators
- solar thermal electric power generation

Coal conversion technologies for low-grade Indian coals:

- fluidized bed combustion
- slagging combustion
- oil and water coal slurry techniques
- coal beneficiation

Technologies to improve the efficiency of major end-use electrical equipment in industry, agriculture and the commercial sector:

- variable speed drives
- motors
- lighting
- effective agricultural pump-sets

Technologies to make better use of available generating capacity:

- load leveling and load management control systems
- energy storage (e.g. off-peak storage of chilled water for air conditioning)
- power plant instrumentation, monitoring and advanced diagnostics
- co-generation systems

Eligible Projects

PACER supports proposals for technology development in any of the priority areas of energy research and development. The main criteria for project eligibility are:

(a) It envisages development of new or innovative product/process relevant to the Indian energy sector.

(b) It indicates significant potential for commercialization within a period of five years

(c) It envisages PACER assistance of upto US $ 3 million or 65 per cent of the estimated cost, whichever is less.

Eligible Applicants

Eligible proposers for PACER assistance are those who:

(a) have formed a consortium of existing profit-making business organization(s), research institution(s) and/or end-users(s) agreeing to jointly work for accomplishing the project goals;

(b) have demonstrated capability in successfully marketing its products developed in response to opportunities;

(c) are ready to enter into an agreement with ICICI which includes an obligation for the profit-making participants to repay the financial assistance to PACER on mutually acceptable terms;

(d) agree that profit-making participants would contribute at least 35 per cent of the cost of the R & D project.

Forms and Terms of Assistance

PACER provides conditional grants to consortia for developing innovative products/processes:

(a) Assistance in the form of conditional grant (in US dollars or rupees as may be necessary) involve liability to repay the amount if the technology commercialization is successful.

(b) Assistance is provided upto US $ 3 million or 65 per cent of the estimated project cost, whichever is less, while the balance amount is brought in by the proposer.

(c) Payments to PACER are in the form of : (i) a negotiated percentage of revenues arising from the project on commercialization; and (ii) are limited to 200 per cent of the PACER contribution towards the project cost.

In case of certain consortium R & D projects eligible for conditional grant, a part/component of the development project might involve more intensive research work which could be undertaken by a research institution/scientist/technocrat. Such research assignment which supports the main consortium R & D project could be considered on its merits for a research award in the form of a grant not exceeding US $ 400,000 or 80% of the estimated cost of the research work, whichever is less.

PACER also provides assistance in the form of a grant towards research projects of relevance to the energy sector in India as well as for formulating consortium R & D proposals in deserving cases.

Pacer Experiences

Till date 16 consortium projects and 8 research projects have been approved under PACER. The assistance sanctioned is Rs. 196 million. Since PACER involves an innovative concept of consortium R & D, involving more than two parties, considerable efforts were required to propagate it. Moreover, energy projects being mainly in the public sector, bringing together various partners, defining their roles and responsibilities and sharing of benefits between them has been an uphill task. Normally projects in the energy sector have large capital outlays (average PACER assistance is Rs. 11.9 million for consortium projects), have longer gestation periods and also high risk elements. The programme has involvement of large organizations, and Government Departments where the decision making process is usually slow.

After initial teething problems, the PACER programme is now gathering momentum. A new *Request for Proposals (RFP)* scheme, has been introduced, inviting proposals from parties on specified subjects, where gaps in technology have been identified and where technology development has promising commercial potential.

Although the financial stakes in technology development in the energy sector are high, some of the projects approved under the PACER programme would have a far-reaching impact on new energy sources and the environment. For example, one of the projects aims at hydrogenation of large grey stone deposits that have been found in North Eastern India to produce a liquid fuel. This helps in the extraction of middle order distillates eg. diesel oil, kerosene, etc. and could reduce imports of petroleum products substantially. Some projects under PACER relate to the development of clean coal technologies. These would substantially reduce pollution from thermal power plants and steam boilers.

SPONSORED RESEARCH AND DEVELOPMENT (SPREAD) PROGRAMME

The Government of India has set up an elaborate chain of 41 National Laboratories covering a wide range of fields such as chemicals, glass and ceramics, fuel, building materials, food, pharamaceuticals, biotechnology, electronics, scientific instruments, leather, petroleum, environment, aeronautics, metallurgy and toxicology.

Although these laboratories have some of the most sophisticated facilities, talented man-power, information databases and other infrastructure their research efforts have been directed mainly towards purely scientific research. Since their financial requirements are met by annual allocations from the Government, they have not felt the need to interact with industry, particularly the private sector. Moreover,

working under government departments, they had elaborate procedures to deal with relating to their own work and in dealing with outside clients. They developed a number of technologies at laboratory and pilot plant scale, but could not provide guarantees for successful working on a commercial scale. Although, fees charged by them were very low, because of cumbersome procedures, lack of interest and absence of guarantees, the private sector could not take advantage of their presence for a long time. The lack of interaction and cooperation between industry and the research institutions led to large scale import of technologies from foreign countries.

Some forward looking companies set-up their own R & D facilities with the incentive provided by the Government in the form of tax reliefs on R & D expenditure, easier import facilities and preferential treatment in licensing. About 1200 in-house R & D facilities have been set-up by the industrial units. However, their main efforts have been in the adaptation of technology, minor modifications, import substitution and solving day-to-day problems. Due to lack of sophisticated facilities, skills and data bases, their efforts in the development of new technologies have been costly and time consuming.

Technological innovations being engines of economic growth and the development of new products and processes having chances of successful commercialization is dependent on controlling costs and a quick introduction in the market. In 1989, a programme, namely, the Sponsored Research and Development (SPREAD) was developed for which World Bank provided funds of US $ 15 million on soft terms and appointed ICICI as the managing agency.

SPREAD Programme aims at encouraging the Indian industrial firms to step up their R & D activities. The Programme envisages utilization of the extensive facilities available with the national laboratories and other independent technology institutions in the country. Each project under the SPREAD Programme, therefore, involves cooperation between an industrial firm and R & D institution.

Objectives of the SPREAD Programme

* To encourage industrial firms to substantially increase their R & D activities
* To foster closer links between industry and technology institutions
* To utilize the existing infrastructure in technology institutions to the fullest extent possible
* To assist industrial firms in improving the cost-effectiveness of R & D projects

Benefits to Industry

The SPREAD Programme is designed to offer the following benefits:

* Support for projects at all the stages of R & D cycle starting from laboratory and prefeasibility studies to prototyping and pilot plant opertions;

* Facilitating access to the large infrastructure of scientific talent and laboratory facilities of the technology institutions in the country;

* Help in obtaining greater mileage out of company's R & D budget through substantial savings in capital investments in major facilities and employment of personnel;

* Encouraging small-scale industries to undertake R & D programme which they would not be in a position to do on their own

* Help in establishing a continuing relationship with technology institutions which can significantly expand the scope of the company's R & D activities.

Eligible Projects

Each project under the SPREAD Programme involves cooperation between an industrial firm and an autonomous, independent technology institution in the country.

Projects eligible for financial assistance under the SPREAD Programme involve:

* Development of a new product or process

* Significant improvements in an existing product or process

* Scaling up of a technology developed by a technology institution.

Eligible Activities

Industrial firms can take up the following activities as part of their R & D projects:

* Prefeasibility studies
* Laboratory trials
* Prototype building/Pilot plant operations.

The long-term R & D programmes ar to be taken up in phases and projects based on successful completion of earlier phases are encouraged.

Project Characteristics

Projects undertaken for financial assistance under the SPREAD Programme are normally those which :

* Have feasible and quantifiable objectives
* Do not take longer than 18 months to 2 years to complete
* Envisage division of major activities between the industrial firms and the technology institution.

Eligible Companies

All companies - whether existing or new, private sector or public sector - are eligible for assistance.

Eligible Technology Institutions

All independent, autonomous technology institutions in the country are eligible. These include :

* National laboratories
* Universities and other educational institutes
* Laboratories and other educational institutes
* Research foundations.

The technology institution with which a project is being sponsored has to have adequate facilities and requisite expertise for successful execution of the proposed project.

The industrial firm and the technology institution with which the project is being sponsored enter into a Memorandum of Understanding spelling out the division of activities, responsibility for execution of individual activity and the implementation schedule.

Eligible Expenditure

Project-specific expenses in respect of any or all of the following items are eligible for financing:

* Equipment and facilities
* Materials and consumables
* Payments to consultants and experts
* Fees payable to technology institutions
* Project related travel and overhead expenses.

All expenses are to be documented and audited annually.

Contribution of the Industrial Firm

An industrial firm has to contribute at least 50% of the total cost of the project.

Maximum Assistance per Industrial Firm

The maximum assistance to an industrial firm would not exceed Rs 125 million. Since the SPREAD Programme seeks to encourage industry to increase its R&D efforts, assistance under the programme is not to substitute ongoing R & D outlays.

Terms and Conditions

* Interest rate of 6% during the implementation period of the R & D project.
* At the conclusion of the R & D project, interest rate increased to 15% alternatively ICICI negotiates royalty payments on commercialization of the R & D project.
* Repayment period of up to 10 years with a suitable provision for a grace period, considering the duration of R & D project.

Project Monitoring

Projects funded by ICICI are closely monitored. ICICI identifies and assigns, wherever necessary, a resource person for monitoring the progress of the project. In addition, ICICI forms a tripartite review committee with representatives from the industrial firm, technology institution and ICICI to review the progress of the project in meeting the technical and economic benchmarks formalized in the proposal and spelt out in the agreement. Disbursement of funds are coordinated with the successful achievements of these benchmarks.

If the sponsoring firm establishes with convincing evidence that the project is not successful, ICICI considers writing off the loan. Such recourse is taken under exceptional circumstances.

The SPREAD Programme which became operational in mid 1990 had a good response from industry and large number of enquiries were received by ICICI. The response from technology institutions that, as a part of the reforms introduced by the Government, have to generate one third of their funds from outside sources-through know-how fees, royalties, consultancy services etc. was also encouraging.

At present 2 proposals involving R & D outlay of Rs 246 million have been approved by ICICI. SPREAD assistance for these proposals amounts to Rs 106 million. The proposals relate to development of technologies relating to drugs, pharmaceuticals, bio-chemicals, machine tools, electronics, environment, polymers etc.

Some of the impact making projects relate to development of technologies for bio-pulping, bleaching and decolorization of effluents in paper industry through microbial treatment, production of environmental friendly detergents using zeolites and the recovery of precious metals from slags by the use of a plasma furnace.

The SPREAD programme is helping individual companies implement R & D projects with a significant savings in cost and time. To ICICI, the SPREAD programme is bringing new, high-tech and fast growing companies. At the national level, it brings the extensive network of Technology Institutions into the industrial mainstream and acts as a catalyst in the development of innovative technologies.

TECHNOLOGY INSTITUTIONS PROGRAMME (TIP)

While on one side the SPREAD programme has the objective of enhanced interaction and co-operation between industrial firms and technology institutions, it has been considered necessary by World Bank to have a scheme to enhance the capability of technology institutions so that they could serve the industrial sector more effectively and also on their own, take up market-oriented technology development projects. A scheme, namely, Technology Institution Programme (TIP) has been designed with a fund of US $ 40 million from the World Bank. Details of this programme are as follows:

Objectives

* To foster closer links between technology institutions and industry
* To help technology institutions upgrade their existing facilities
* To help technology institutions set up new facilities for emerging technologies
* To help technology institutions market their services to industry.

Eligible Technology Institutions

Independent, autonomous institutions or agencies including:

* National laboratories
* Laboratories set up by industry associations
* Research foundations.

Eligible Activities

Technology institutions to take up the following activities as part of their programmes:

* Setting up of pilot plant facilities and testing equipment
* Upgrading management systems and safety procedures
* Technical collaborations
* Training and exchange programmes
* Strengthening marketing capabilities.

Programme Characteristics

Programmes undertaken by the technology institutions have to:

* Reflect the need of a specific sector in an industry
* Be completed in no longer than 2 to 3 years
* Have significant potential for generating revenues from industry through sponsored projects, consultancy services and testing fees.

Eligible Expenditure

Programme-specific expenses in respect of the following items are eligible for financing:

* Equipment and facilities
* Materials and special samples
* Technology collaboration fees
* Training and exchange programmes with industry and foreign collaborators.

Terms of assistance

Programme undertaken by the technology institutions should have:

* An annual service charge at 1%
* A front-end fee at 0.25%
* A repayment period of upto 15 years with suitable provision for a grace period considering the time required for implementing the programme.

Contributions of the Technology Institution and Industry

Since the TIP aims at helping the institutions set up facilities that will be useful to industry and help in generation of external revenues, the technology institution and industry are expected to make appropriate contributions towards the cost of the programme which is decided on a case-to-case basis.

Under this programme, Technology Institutions for the first time have to take a loan, which is to be repaid out of their own earnings. This is a major change in their culture, thinking and approach, since so far they have been accustomed to receive only grants from various agencies to carry on their work. The initial response for TIP was slow, but because of the directives to increase their earnings from external sources, increasing number of institutions are formulating proposals to obtain assistance under this scheme.

So far, ICICI has sanctioned assistance to 8 institutions for an aggregate amount of Rs. 425 million.

Recently, Government has indicated possibility of further reductions in the budgetary support to technology institutions, urging them to take up more industry and market oriented developmental work and generate income from outside sources. This is likely to bring about a major change in the working of the technology institutions and bring them closer to the industry. The TIP is likely to play a role of great importance in this transformation and boost development of market oriented R & D in the country.

MANAGEMENT OF TECHNOLOGY (MOT)

Although a large number of persons are employed in R & D institutions in India, there is no programme in the country to upgrade their knowledge on the Management of Technology - which has become a complex subject and at the same time is considered to be very important if the companies are to face competition - both local as well as international. Only those companies that pay attention to this subject could expect to achieve and maintain their leadership in industry. More awareness of this nature is coming to industry and progressive companies are looking for suitable programmes to train their personnel in the art of management technology.

ICICI conducted a survey and held work-shops inviting industry, universities, IITs and management experts to suggest on the content and duration of programmes for technology/engineering graduates as well as practising R & D managers and technologists engaged in R & D activities. It is proposed to offer several modules of short, medium and long term duration so that persons at different levels could participate in such programmes. The Science Policy Research Unit (SPRU) at the University of Sussex, U.K. is assisting ICICI in designing the programmes - which would be implemented by different organizations such as IITs, Institute of Management, technical universities and industry organizations.

CENTRE FOR TECHNOLOGY DEVELOPMENT (CTD)

Under this scheme, a non-profit-making society has been registered at Bangalore in the Karnataka State in 1988 with the broad objective of Technology Development, Promotion of R & D, Garnering of Assistance for technology Development in support of hi-tech industries, Promotion of Venture Capital Schemes, Human Resource Development in the technology sphere and Provision of Information on Technology.

The main activities of CTD are carried through focus groups comprising representatives from scientific and academic institutions, industry, financial circles and Government. Focus Groups formulate schemes which are implemented with 50% support from industry. CTD has set up Focus Groups for Informatics, Food Processing, New Materials and Dryland Development and commenced action towards setting up centres for applied technology relating to food processing, manufacturing engineering and tree crops in collaboration with Centre for Advanced Food

Technology at Rutgers University and Carnegie Mellon University for programme in Robotics.

CTD has set up a National Venture Capital Forum to provide training and advice to entrepreneurs on Venture Capital proposals. CTD has assisted various agencies in human resource development, the use of computers and computer aided designs. It is planning to extend activities to other states.

Funds for the Centre are provided by USAID ($ 10 M) and State Governments and user agencies (US $ 0.45 m). The Centre is managed by an autonomous Board of Governors representing prominent persons. ICICI channels USAID funds to implement the programmes of the CTD.

FINANCING COMMERCIALIZATION OF TECHNOLOGY

Term lending institutions in India have traditionally financed only those projects that have a proven source of technology and good commercial potential. Occasionally they receive requests from entrepreneurs for setting up projects based on locally developed technologies with no proven track record. Generally institutions have been weary of backing such projects. In a few cases they have financed projects after taking safeguards such as setting up a pilot plant of a capacity where scale-up would not be a major problem or where the projects were being set-up by large industrial houses that could mobilize resources to solve problems. Many projects conceived by young entrepreneurs, particularly those belonging to the scientific community, could not be implemented as no institution was ready to to take the necessary risk.

By 1988, ICICI had been involved in financing the development of indigenous technology through its various schemes. However, it became clear that there was no mechanism available to bring these technologies to the market place since they were new and unproven. Financial institutions and banks were not inclined to finance such projects as the risks involved were high. Several young persons with bright ideas but inadequate financial support, many of them working in technology institutions were looking for schemes that could turn their ideas into practice.

ICICI was aware that *Venture Capital Finance (VCF)* was playing an important role during the past 2 to 3 decades as a lubricant that made high technology enterprises and innovative services run smoothly. In the United States of America, it created billion dollar products and services like the Apple Personal Computer and the Federal Express Service. VCF also played an important role in Japan, Europe and even in some developing countries in bringing out technologies from research laboratories to the market place.

ICICI through its earlier experiences of technology finance through the instruments of conditional grant and conditional loans was aware of these new ventures. It was also familiar with the evaluation of risk and returns from such

proposals. ICICI realized that the lack of venture capital was a major gap in the Indian financial system. As one of the institutions which had pioneered many new concepts and institutions, ICICI decided to provide Venture Capital Finance for projects with high risks but also high returns on successful commercialization. Some of the projects from the existing portfolio of ICICI meeting the above criteria were identified for transfer to venture capital. It was also realized that handling of such proposals needed a new kind of approach and an attitude different from the approach of traditional banking. Hence, a new institution was created under the name of the *Technology Development and Information Company of India Limited (TDICI)*, with Headquarters in Bangalore, a city where a large number of high-tech projects in telecommunication, aeronautics, computers etc. are located employing a large number of qualified and experienced persons with a scientific background.

TDICI was started with a Venture Capital Fund of Rs. 200 million, subscribed equally by ICICI and the Unit Trust of India with the aim of accelerating the pace of Indian technological development by offering venture capital and support services to industry and the service sector. Operations from the fund were started in March 1989. Response to the fund was overwhelming and in less than one year, 38 high-tech projects were financed from this fund. These projects cover a wide range of industries : computer hardware/software, electronics and telecommunications, chemicals, polymers and special materials, biotechnology, environmental engineering, renewable energy sources, drugs, pharmaceuticals, diagnosis and vaccines, food and feed technology, electrical and mechanical equipment and new services.

Assistance from TDICI is provided to first generation entrepreneurs/technocrats for projects/services with the four high factors of innovation, growth, risk and reward. The assistance is extended in the form of equity participation up to a maximum of 49% and a flexible instrument-conditional loan working on the principle of "payment according to the earning capacity". Both equity and conditional loan are risk and reward sharing instruments. In addition, the conditional grants have features of equity but no voting rights, a procedure which is preferred by entrepreneurs who retain control of the Company. The payment in the form of royalties on sale is fixed depending on the profitability of the company and estimate of a reasonable yield. The overall performance of the first fund has been satisfactory. A dividend of 15% to the investors has been declared by TDICI each year from inception.

In 1990 TDICI, constituted a second fund amounting to Rs 1 billion which received a contribution from ICICI, UTI, IFC - Washington, Commonwealth Development Corporation, Indian Banks and the Corporate Sector. About 70 new projects with an assistance of Rs. 350 million have been financed from the second fund. Apart from high-tech areas projects requiring innovative marketing approaches and new services have been included under this fund.

Industry-wise break-up of the TDIDI's support to industry is as follows:

Industry	No. of Companies	Amount in millions of Rs.	%
Computers HW/SW/CAM/Systems	251	33.4	24
Chemicals/Polymers/Spl.Materials	21	75.9	13
Drugs/Diagnostics/Vaccines	12	73.4	13
Services/Others	14	68.1	12
Food/Feed/Fisheries	8	67.1	12
Electrical/Electronics/Telecom	13	54.6	9
Engineering/Non-Conv.Energy	16	50.8	9
Consumer Products	4	22.6	4
Biotechnology	3	18.4	3
Mechanical Equipment/Systems	1	2.0	1
Total	117	567.3	100

Some of the proposals supported under Venture Capital relate to the treatment of spent wash from distilleries, manufacture of fuel pellets from agricultural and municipal solid waste, development of hybrid seeds, development of speciality and medicinal gum products, miniature sensitive relays for the telecom industry, paints and coatings based on engineering polymers, rubberwood mouldings and components, home computers and intelligent note pads, seismic date acquisition for the Oil and Natural Gas Commission.

TDICI is India's first, fastest growing and largest technology venture capital corporation. It has played an important role in meeting the venture capital requirements of new and expanding companies in their early stages.

The venture capital industry has now been in existence for about five years. The Government of India, recognizing the need to develop an institutional framework for venture capital in India, announced investment guidelines for venture capital industry during 1989 along with certain capital gains tax incentives. Since then, the industry has gradually grown over a period of three years. Today, there are eleven companies/financial institutions in the venture capital area. While some have been constituted as venture capital companies that have raised equity capital for investing, the more popular form of organization has been a fund management company similar to an asset management company as in the case of mutual funds. During the last five

years, the venture capital companies/funds (VCCs/VCFs) have invested about Rs. 1 billion in over 200 enterprises.

The performance of the venture capital industry may at best be considered moderate, considering the fact that the annual rate of lending to the industrial sector by various financial institutions is in excess of Rs. 15,000 crores.

Some of the problems faced by the venture capital industry are:

(a) Restrictive nature of present investment guidelines; and
(b) Inadequate tax concessions for the industry.

The present set of guidelines stipulates that 75% of the venture funds should be invested in companies set up by relatively unknown entrepreneurs and/or in businesses commercializing unproven technologies. The guidelines may be interpreted as permitting investment only in manufacturing companies attempting new technologies. They deny investments in service sectors and in areas that may not be technology oriented. Given the present level of technology development activity in the corporate sector, there are not many investment opportunities for the VCCs/VCFs under the present guidelines.

The present income tax rules allow a 50% concession to the venture capital industry for capital gains tax. However, the industry is taxed normally on any other form of income. Due to restrictions on the issue of capital and pricing of equity that were in force until recently, the venture capital industry had to consider, in the past, non-equity financing in a significant way in order to lend effective support to their investee companies. The income derived on such non-equity financing is subject to tax at normal rates. The fiscal incentives provided so far are inadequate and need to be re-examined.

In this regard, it may be mentioned that the Government has recently granted a total tax exemption to mutual funds. The venture capital industry takes a much greater degree of business risk by investing in start-up and young companies for a long-term period. There is, therefore, a need to place the venture capital industry on par with mutual funds by providing a total tax exemption.

If an appropriate environment is created through the above changes, the venture capital industry can play a far greater role in the industrial development of the country by providing equity capital to new businesses. It is expected that the loan support from financial institutions will be increasingly difficult for new companies, given their resource constraints. Besides, with liberalized norms for equity pricing and the consequent decline in investor returns, the public support for equity issues of new companies would also decline. The venture capital industry will be in a position to bridge this emerging gap in the financial sector.

AGRICULTURAL COMMERCIALIZATION & ENTERPRISE (ACE)

Apart from the goal of commercialization of technologies through the Venture Capital Finance route, ICICI has recently commenced the implementation of two more schemes which are related to specific sectors *viz.* Horticulture and Enviroment.

The Agricultural Commercialization and Enterprise (ACE) Project relates to the commercialization of technologies in the post-harvest horticulture activities. The genesis of this scheme is that India, with more than 8.7 million hectares area under fruits and vegetables is one of the world's largest producers of vegetables - next only to China and third largest producer of fruits - next to Brazil and USA. Despite this large production, a lack of proper technology and modern support services in the post harvest activities results in nearly 30% of the production, amounting to Rs. 30 billion, being wasted every year, between the farmgate and the consumer. Due to indequate processing facilities, India's share in the world market of horticulture produce is less than 1 per cent.

The ACE programme has been designed to address the critical deficiency in the post-farm horticulture sector. The programme provides technical and financial assistance to acquire state-of-the-art technologies required for post-harvest operations for fruits, vegetables and flowers.

The major emphasis of the ACE project is in minimizing post-harvest losses and increasing the shelf life by using new technologies like mobile pre-cooling, individual quick freezing, freeze drying and other techniques. The other emphasis of ACE is on high value addition through setting up of processing units with modern facilities for sorting, grading, processing and packaging. With these facilities, the availability period for fruits and vegetables can be extended enabling farmers to realize higher prices for their produce.

Apart from providing loans to support the above activities, the programme envisages *Technical Assistance (TA)* for obtaining state-of-the-art technology, equipment, market information and tie-up support for joint ventures and exports. Another component of the ACE programme is *Trade and Investment Tours (TI)* by Indian horticultural entrepreneurs and organizations to visit foreign firms and participate in exhibitions and seminars to acquaint themselves with the latest technologies, equipment, processes and farm practices. They can also avail themselves of the services of foreign experts for improving their operations. Whereas loans are provided on market terms, TA and TI are provided as grants to the extent of 75% of the cost.

The programme also envisages conducting sectoral studies to examine gaps in the technology and healthy development of various sectors, policy studies to reduce bottle-necks, enhance prospects of commercialization and export earnings. In

addition, training programmes for institutional offcers and entrepreneurs in India and abroad are also envisaged.

ICICI has constituted an Advisory Council comprising representatives of industry, government, commercial banks, management institutions, scientists, agricultural universities etc. to provide guidance for the programme. ACE has a panel of experts to assist in the evaluation and monitoring of proposals. ICICI has access to a firm of agro-business international consultants for advice and sourcing of technologies, experts, equipment and market information. ICICI's ACE group comprises chemical engineers, technologists, agro-economists and financers.

The ACE programme with a fund of US $ 20 million from USAID comprising US $ 10 million to be provided as loans and US $ 10 million to be used in providing Technical Assistance has just commenced operations, initially in one of the states in India. About 50 proposals/ enquiries have been received for obtaining latest technologies, market tie-ups and value addition for mango, banana, grapes, guava, pomegranate, cashew, berries, orange and citrus fruits, papaya, pineapple, onion, mushroom, cabbage, carrot, bitter gourd, baby corn etc.

The programme is expected to act as a catalyst in developing a modern and dynamic agro-industrial base in the country.

TRADE IN ENVIRONMENTAL SERVICES AND TECHNOLOGY (TEST)

India has developed a fairly large industrial base over the last five decades. It meets almost all the basic requirements of the country from major manufacturing industries viz. steel, cement, paper, sugar and textiles - both cotton and synthetic. India has also a large production base of fertilizers, petroleum products, dyes, pesticides, polymers etc. The engineering industry today can supply virtually the entire requirements of automobiles, railways, power plants and machinery for sugar, cement and textile manufacture, telecommunications, entertainment and industrial electronics.

The rapid industrialization of the country has also created major pollution problems relating to the atmosphere, water and land mass. Because of limited resources and large investments required in controlling pollution, without significant returns, the industry did not provide adequate attention on this aspect. Only with the creation of legislation and its increasing enforcement resulting in penalties and closure notices, has industry started vigorous action to solve their pollution problems.

From the beginning, ICICI has been paying attention to the environmental problems of the industry and providing modest amounts on treatment and disposal of effluents for individual units. However, ICICI's involvement has been mainly with medium and large scale plants in the private sector. There are innumerable units in

the small scale and other sectors who have not been assisted by ICICI and are facing serious pollution problems due to out-dated technologies and inadequate attention to this problem. In metropolitan cities, a large concentration of automobiles with very poor combustion efficiencies have created serious problems with hazardous emissions, that affect health.

In 1990, the World Bank provided a special line of credit of US $ 50 million to ICICI for advancing assistance to industry on softer terms in solving their pollution problems. However, it was found that there are large gaps in technology in certain areas and there is a need to have information not only on the state-of-the-art technologies for various sectors, but also about consulting agencies and experts who could bring developers/suppliers of technology, equipment, engineering designs etc. to the users and arrange for know-how development, adaptation, transfer, etc. The parties could also set-up joint ventures in India to provide clean technologies to various sectors of Indian industry.

A new programme TEST is being just introduced by ICICI with a fund of US $ 25 million from USAID. The innovative features of this programme are net working of institutions involved in solving environmental problems, access to latest information through satellite communication with various databases and specialized agencies and quick dissemination of information to various organisations. TEST also envisages involvement of consultancy firms and experts in the environmental field to provide services in solving problems of highly polluting industries like leather, paper, dyes, pesticides, distilleries, chemicals etc. on individual unit as well as sectorial basis.

One of the major objectives of the TEST programme is to enhance the productivity of Indian industry on a sustainable basis i.e. by adapting affordable technologies, which provide recoveries of products/by-products of economic value or alternate technologies which are relatively clean involving reuse/recycle of waste streams, efficient firing of boilers to reduce exhaust emissions and reduction of noise pollution by better design.

Apart from financial assistance, technical assistance under TEST programme is also available for exchange visits, work-shops and conferences, assessment of specific pollution abatement needs and access to updated information from net-works and databases on environmental services and technologies.

ICICI has started on the formation of TEST Advisory Board, expert panels and TEST group to implement the project. Under this programme, for the first time ICICI, through its own personnel stationed in the USA, would have direct interaction with organizations involved in the solution of environmental problems.

CONCLUSIONS

ICICI, starting as a development finance institution in mid-fifties, has diversified its operations from project finance to merchant banking and advisory services. For more than a decade it has increased its role in the field of Technology Finance and Commercialization.

Managed by professionals of high calibre and commitment - from the level of Chairman to Officers, ICICI has an atmosphere of efficiency and competitiveness together with courtesy to its clients. With delegation of authority at different levels, simplified procedures and quick communication, the decision making process in ICICI is quite fast. As a result, industry associations, government departments and various national and international organizations prefer to deal with ICICI.

With a large number of contacts with Indian Industry and a good financial record, ICICI has received support from organizations like the World Bank, KFW, ADB, USAID, CDFC, EC, DANIDA, the Swiss, French and Swedish Governments, commercial banks and financial institutions in the U.S.A., Germany, Japan, U.K., France, Canada and Switzerland. Several joint schemes and ventures are being implementated with these agencies.

As far as the Technology Finance and Commercialization are concerned, major support to ICICI has come from the USAID, World Bank and KFW. In many of these programmes, ICICI plays the role of an implementing agency. Except partially covering its costs, ICICI does not make a profit from implementing these programmes. All the reflows are ploughed back to revolving funds, which are used for the same purpose for which the different funds were created. An important feature of these schemes is that the cost of their implementation by ICICI is about US $ 100,000 per scheme per year, which could be considered quite economical.

The amounts provided for various programmes are quite modest, considering the requirements of a country of the size of India. However, these programmes play a catalytic role and have created a strong awareness in industry about the important role technology development can play in improving quality, productivity and competitiveness, which are important in the process of globalization. These programmes play the role of "path-finders" and many organizations in India and abroad are developing programmes on similar lines.

Despite several bottle-necks and initial teething troubles, on the whole the experience of ICICI in implementing these programmes has been satisfactory. Persons and organizations that are associated with implementing these programmes have developed a sense of pride in their role in technological development. ICICI is

ready to share its experiences with developing and developed countries and join them in the design and implementation of similar programmes.

(A.J. Advani is the General Manager of ICICI. This article is based on a paper presented at the STEPAN meeting on Managing Research Systems in Developing Countries held in Hanoi, Vietnam, December 8-11, 1992).