

INDIAN SPONSORED RESEARCH AND
DEVELOPMENT SUPPORT PROGRAM:
A MODEL FOR PROMOTING
UNIVERSITY-INDUSTRY-GOVERNMENT
TECHNOLOGY COLLABORATION

BY

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Indian Sponsored Research and Development Support Program: A Model for Promoting University-Industry-Government Technology Collaboration*

Abstract

This article presents the historical development, structure and process of implementing the Indian Sponsored Research and Development (SPREAD) program, as a successful model of promoting university-industry-government interaction and technology collaboration. SPREAD was a technology support program implemented by the Industrial Credit and Investment Corporation of India, a development financial institution, on behalf of the Government of India. Sponsored as a pilot project by the World Bank in 1991, the SPREAD program was meant specifically for supporting university-industry joint research and development projects within India. SPREAD supported over a hundred such joint projects resulting in more funds being diverted to it than initially planned. The article presents the country context for the initiation of the SPREAD program, its structure and the nature of financing provided under it. It also covers the SPREAD program implementation process, the benefits seen by the firm, initial project selection process, detailed project proposal requirements from the firm, project appraisal process, sanction process, selection criteria, post sanction activities, and assistance given to the firm under the program. The paper finally presents a diagrammatic representation of the support structure for promotion of university-industry-government interaction and technology collaboration as shown in this program.

* This paper draws extensively on interviews with officers of the Industrial Credit and Investment Corporation of India (ICICI) that implemented the Sponsored Research and Development (SPREAD) program, interviews with the sponsored project participants, the ICICI brochure on the program (ICICI undated), the program appraisal and documentation formats at ICICI, an article in *Business India* (1993) and a World Bank assessment report by Najmabadi and Lal (1995) covering the program. Line by line references to all these sources are avoided (except for direct quotations) for better readability.

Context of University and Technology Institution Research for Industry in India

India has a large number of universities and technology institutions catering to a variety of specialized areas of technology development for industrial application. Apart from the large number of technology universities and autonomous technology education institutions in the country, there is a large network of national laboratories under various central and state ministries, research laboratories set up by industry associations and research foundations that conduct industrial research. Universities and autonomous technology educational institutions, including world renowned institutions like the Indian Institute of Science and the five Indian Institutes of Technology, conduct both basic and applied research with only one of their multiple and often diverse objectives being to develop technology for the industry. Research foundations in India have objectives ranging from working for specific sectors to working on wider interdisciplinary developmental issues. While the National Laboratories under India's Council for Scientific and Industrial Research exist primarily for industrial research, other National Laboratories under other research councils also contribute to industry relevant research. Many of these National Laboratories are also deemed universities and grant degrees and doctorates. Research laboratories in nationally important and sensitive fields like space, defence and atomic energy are fully supported and controlled directly by the government. These too transfer some of the technologies they develop for industrial applications in India.

Financial Support for Sponsored Industrial Research in India

While some industrial firms in India have financed research contracts with universities and technological institutions on their own, this has been considered highly inadequate by the government. The Indian government and developmental financial institutions have therefore taken steps to subsidize financing of research and development (R&D) contracts by Indian firms to universities or technology institutions to make such potential contracts more viable.

The government gives firms a higher tax credit (@125% of expenses) for payments made to universities and technological institutions for contract research compared to the normal tax credit (@100% of expenses) available for in-house research by the firm. Development financial institutions in India give conditional grants or concessional loans for technology development and enterprise creation activities, with the help of universities and technology institutions (Jequier and Hu 1989). Such initiatives are expected to encourage firms to utilize the extensive facilities available with the universities and technological institutions in the country to develop new technology or to commercialize their available technology. However such passive forms of support have not yielded adequate results in terms of increasing research collaborations and eventually increasing industrial R&D activity in India (Chaudhuri and Dixit 1994).

The Industrial Credit and Investment Corporation of India (ICICI), a premier Indian development financial institution, has developed and implemented specific programs to promote university-industry interaction through funding from the United States Agency for Industrial Development and the World Bank (Advani undated). It was selected as the agency to implement a large part of the US\$ 200 million Industrial Technology Development Project funded by the World Bank. Under this project, the US\$ 15 million Sponsored Research and Development (SPREAD) program provided soft loans for university-industry joint R&D projects and the US\$ 40 million Technology Institution program provided financial assistance to universities and technological institutions in upgrading their facilities and enhancing their expertise to serve the R&D needs of the industry more effectively. Apart from these, venture capital finance for commercialization of innovative technologies was provided by a venture capital firm promoted by ICICI, with partial funding from the US\$ 45 million World Bank funding of venture capital as part of the Industrial Technology Development Project. The objectives of the Industrial Technology Development Project were "to provide functional support for technology imports, to strengthen the science and technology infrastructure and

make it relevant to industry and to promote innovation financing" (Najmabadi and Lall 1995, 90).

Among development financial institution's technology development programs that in effect support university-firm interaction in India, the SPREAD program was specially designed for and aimed specifically at such interaction. One of its stated objectives was "to foster closer links between industry and technology institutions" (ICICI, undated). The innovative SPREAD program was unique in India and among developing nations in requiring formal university -industry co-operation as a necessary condition for project financing.

Initiation of the SPREAD Program

In the late 1980`s, an ICICI internal survey of Indian industrial research had identified areas of industry problems and opportunities. It had identified the need to bring about linkage of industry and technological institutions. The Abid Husain Committee report on the same topic was tabled in the Indian parliament around the same time and also stressed the same need. The World Bank in their pre-project mission had met people in the government, industry, technological institutions and development financial institutions and made similar assessments. Based on these studies and assessments the World Bank formulated its US\$ 200 million Industrial Technology Development Project aimed at industrial infrastructure development for India along with similar projects in other developing and newly industrialized countries. The objectives of Industrial Technology Development Project were "to provide functional support for technology imports, to strengthen the science and technology infrastructure and make it relevant to industry and to promote innovation financing" (Najmabadi and Lall 1995, 90).

Under the Industrial Technology Development Project, the US\$ 40 million Technology Institution program was the first program to be formulated. The Technology Institution

program was based primarily on the Abid Husain committee report to the parliament which pointed out that Indian universities and technological institutions lacked facilities to go from laboratory scale to commercial scale technology development which was essential for meeting industrial needs. The Technology Institution program met this gap by providing financial assistance to universities and technology institutions for upgrading their facilities to conduct commercial scale technology development for immediate transfer to the industry.

The World Bank and the ICICI also believed that strengthening the university and technology institution infrastructure alone was not sufficient as the demand for their services was not enough - in other words firms were not approaching them even when they had the required infrastructure. The SPREAD program was therefore developed and launched in 1991 under the Industrial Technology Development Project. The SPREAD program was meant specifically to encourage Indian industry to contract research institutes in the country for technology development, by providing soft loans for university-industry joint R&D projects. This was part of the World Bank's aim to provide venture finance like services for technology development in India. The World Bank initially provided US \$15 million to the Government of India towards the implementation of the SPREAD program. A revolving fund was created which was managed entirely by the ICICI (see Table 1 for the structure of the SPREAD program). According to a SPREAD program project coordinator in ICICI, "ICICI is playing the role of a catalyst - it is an additional service to the industry."

The SPREAD program was a pilot project of the World Bank. It has been described as "innovative and imaginatively designed" by a World Bank assessment team (Najmabadi and Lall, 1995, p.90). The ICICI also simultaneously took up technology development venture funding through the Technology Development and Information Company of India, a venture capital firm promoted by ICICI, with partial funding from the US\$ 45 million World Bank funding of venture capital as part of the Industrial Technology Development Project. This firm

provided venture capital finance primarily for commercialization of innovative technologies. According to a SPREAD program project coordinator in ICICI, "The venture capital fund is a connected activity. Some of our projects (under SPREAD) later go to venture capital financing. ICICI can also take up commercial funding of the projects and provide future support for commercialization."

Table 1 about here

Program Implementation at the ICICI

ICICI's interest in this program emerged from their success in the United States Agency for Industrial Development supported Program for Acceleration of Commercial Technology (PACT) which promoted Indo-United States joint R&D projects with either Indian or United States commercialization. In the words of a SPREAD program coordinator in ICICI, "ICICI has funded over ten thousand projects since its inception and a majority involved foreign exchange import payments and technology transfer fees. Seeing the technology flow from abroad but not emerging from the Indian industry, we felt that this should be changed. Learning from the success and experience of PACT, ICICI saw the potential in the SPREAD program."

A senior level manager at ICICI, who was then with PACT, and had worked in industry in R&D for several years before that, was given charge of implementing the SPREAD program. Initially a temporarily internally transferred person assisted him. Within three months, four executives were recruited to assist in the project appraisal, assessment and co-ordination activities of the program. They all had engineering qualifications and four to five years of industrial experience in areas like new product development, engineering, production, quality control and technology transfer prior to joining ICICI.

For initial publicity, ICICI organized a program launch seminar at each major city in India for which chief executives from local firms were invited. Large seminars were organized through ICICI zonal offices in a number of cities all over India. The ICICI team also participated in several seminars organized by the industry, including general seminars, technical seminars and industry specific seminars where they made presentations on the Technology Institution program and the SPREAD program. Program brochures were sent to all major industrial clients of ICICI that were active in R&D, to firms that had the Department of Scientific and Industrial Research recognized R&D units, and to industry associations. To update their list for sending brochures on a continuous basis, ICICI checked on companies that were recruiting R&D professionals and followed up on companies through magazines and industry association publications. Also each university and technology institution participating in the Technology Institution program regularly sent ICICI an activity report that mentioned the list of firms involved in consulting projects - helping ICICI expand and update its list.

As ICICI is a premier financial institution in India (Pandey 1990), it is a consortium member for institutional investments in most large firms in India. These firms therefore regularly contact ICICI and visit it frequently. ICICI representatives are also on the board of directors of several firms. So apart from the brochures and industry conferences, these firms informally came to know about the SPREAD program through this frequent contact with ICICI. Other firms that had no previous contact with the ICICI came to know about the SPREAD program through articles in industry journals or through announcements in industry association circulars. Since the program was new to the country at that time and was evolving, ICICI typically did not face a wide choice of proposals during the initial year of the program.

Program Implementation Team

The program implementation was headed by the manager of the Technology Group located at ICICI headquarters in Bombay. He administered the SPREAD program along with the other technology development programs of ICICI. As head of the technology group, he was responsible for monitoring the evaluation of SPREAD financing project proposals from firms, their being placed before the ICICI Approvals Board of which he was also a member, monitoring the project progress and controlling funds disbursement.

He was assisted by four executives who worked exclusively on the SPREAD program. They acted as project coordinators from ICICI for the projects funded under the program. Each executive was allotted roughly a quarter of the projects according to their interest and technology competence areas. The first executive was a metallurgical engineer and he usually handled all projects in the metallurgical and materials area. The second, an electronics engineer usually handled projects involving electrical and electronic products. The third, a pharmaceutical technologist handled projects in pharmaceuticals. The fourth, a chemical engineer handled projects in chemical technology. A majority of SPREAD projects were proposed in these six technological areas. Projects from fields other than these six areas were usually distributed in such a way that the workload evened out.

The project coordinators usually sought help from each other and from other technically qualified and experienced people within and outside ICICI for clarification on technical matters. Their responsibilities include helping the firm develop the project proposal as required, preparing an evaluation report with recommendations, placing the report before the ICICI Approvals Board and once approved, monitoring the project progress and controlling funds disbursement according to the norms of the program.

SPREAD Financing Benefits

Why have Indian firms opted for financing their R&D projects under the SPREAD program? Interviews with chief executives or top management of firms participating in the program indicate that the benefits seen by firms are varied. The overriding reason was that commercial banks in India did not finance R&D projects and therefore such projects had to be largely financed through internal resources. Other benefits of opting for SPREAD finance depended on the nature of the R&D project and the firm's context. Firms that had a relatively low-technical risk - high investment R&D project or a portfolio of R&D projects of this nature, usually saw the primary benefit as getting a loan at a low interest rate. This enabled them to expand the scope of their R&D project or enlarge their new product development portfolio beyond their internal investment capacity. Firms that had relatively high technical risk - high investment R&D projects, usually saw the primary benefit as risk reduction by the 50% funding and the option of appealing for non-payment in case of project failure. Firms with relatively low investment R&D projects, irrespective of the level of technical risk involved, also opted for SPREAD financing if they did not have sufficient investment capacity. They usually saw the major advantages in taking SPREAD financing as (a) low interest rates, (b) repayment over a longer period and (c) the loan being free of the need to hypothecate their assets. The last gave these firms an additional line of credit and increased their borrowing capacity as they could hypothecate their assets for working capital and other loans. In all cases, the benefits of financing under the SPREAD program could combine with the greater tax credit available in India for R&D projects subcontracted out to institutions, to make a potential R&D project more financially viable.

Initial Project Screening and Selection

The SPREAD program brochure sent by ICICI to prospective firms (ICICI, undated) included a format for them to prepare a preliminary project proposal (Table 2 lists the information required by ICICI in the preliminary proposal from the firm). However, before preparing the preliminary proposal, the firm usually had a preliminary discussion with an ICICI project coordinator to make an initial assessment of the eligibility of the project under the SPREAD program. The ICICI team assessed the preliminary proposal primarily on its developmental content and commercialization potential. The preliminary proposal could be rejected on several grounds such as:

- (a) The development content was low (é.g. only a small change in the product was being attempted - the development had to be a significant improvement for being supported).
- (b) Material availability was likely to be a problem in the project.
- (c) It was a repetitive type of product - it had been attempted before by another institution - in such cases the ICICI advised the firm to go to that institution so that there was no duplication of effort.
- (d) There was no clear division of work responsibility between institution and firm it had to be a joint project to be supported.
- (e) The gestation period was very long (five to six years) - ICICI was interested in a two to three year total developmental cycle.
- (f) The market was limited, not established yet or major efforts were required to build the market (unless there was financial backing of a large business house that could invest in the commercialization).

On historical analysis, some projects were rejected during the assessment process if the promoter background was poor - e.g. the promoter had been a financial defaulter or had siphoned cash in the past. In the case of smaller firms, the firm was also required to identify

potential customer(s), establish a dialogue with them and get their support. In other words, the firm has to establish user commitment or the link with users. The ICICI checked carefully whether the basic guidelines for SPREAD financing were being followed - e.g. that the institution played a complementary role in the project and was actually being utilized, that the firm was only listing equipment for finance that was specific to the proposed project and not other equipment.

Based on their experience, the ICICI team also assessed the technical feasibility of the project - e.g. in chemical projects, if the scale up factor from laboratory scale to pilot scale was too high, implementation problems could be anticipated. If problems were anticipated, ICICI advised the firm to reassess the project - possibly with help from external experts. Over ambitious projects and targets that were proposed by inexperienced firms were often toned down. Some projects were restructured so as to require the firm to do it in stages and financing for each stage was made dependent on achieving success in the previous stage. Some R&D activities were also broken up into independent components and the firm was asked to contact institutions and see if each component was feasible. These suggestions were usually given in the nature of guidelines by ICICI rather than as stipulations for sanctioning the loan.

Table 2 about here

Detailed Proposal Requirements

Based on the firm's preliminary proposal and discussions, a customized detailed proposal format was created for the firm by the ICICI team. Initially the ICICI team had developed a common detailed proposal format for all types of projects. However, during the first few projects under the program, they realized that there were difficulties in using a common format due to industry and technology related differences between projects. This either made the

common format inadequate or rendered parts of it redundant. So instead of expanding the common format to cover all contingencies, customized formats were developed by the ICICI team for subsequent projects, based either on the technology area or the project's specific requirements. While these detailed proposal formats were customized to each firm and each project, this customization was largely for the project's specific technology area requirements. Other details are usually common across all formats.

A project coordinator at ICICI, described the process of developing the customized detailed proposal format as follows:

"We try to understand the requirements - raw material and machinery - its availability and price. Does the new product require new machinery or does it use the existing set up? We then look into the performance parameters that will be used (e.g. efficiency, specifications and time for completion) to define the technical fit of the project. We estimate the chances of the product working commercially in the desired conditions. Knowing the industry is important. We should know what is important in that industry - e.g. in chemicals the yields, by-products and energy consumption is important; in electronics standardization, compactness and cost reduction is important; in pharmaceuticals regulatory factors are important. Once technical details are clear then we examine the direction of development and ask for data on how it will be done. What is being attempted and what is its impact on the end product? The cost may go up but is the quality better? Will the consumer pay more for reliability? Based on all these the customized format is prepared."

Appraisal Report and Sanction Process

Before the appraisal report was prepared, the designated ICICI project coordinator and the manager of the Technology Group at ICICI visited the firm to examine their facilities and

meet project participants. They examined the firm's current activities, the quality rejection levels, capability, R&D structure, organization etc. They also talked to the firm's major customers if required. They then visited the university or technology institution jointly with the firm personnel, met the scientists participating in the project and examined the adequacy of the institution's R&D facilities. They also examined the track record of the university or technology institution and their scientists - their background, record of projects completed or left incomplete, the composition of the project team (qualifications, experience and multi-disciplinary representation required for the project), the time available with the scientists for such work, their experience in industrial research and with the firm's personnel, and nature of their past interaction with industry.

On the basis of their filled in detailed proposal, the visits and discussions, the designated ICICI project coordinator prepared the project appraisal report in consultation with the manager of the Technology Group at ICICI. This report was circulated among the Approvals Board members - consisting of directors of technology industries, ICICI directors and the manager of the Technology Group at ICICI. They received these reports about ten to fifteen days in advance of the Approvals Board meeting. The project proposal was then presented by the ICICI project coordinator and discussed in the Approvals Board meeting held every three months. If required, a representative from the firm and/or the university or technology institution was also asked to make a presentation on the proposal to the Approvals Board in this meeting. The board questioned the ICICI project appraiser and the technology institution or university or firm representative attending the meeting and made suggestions. This questioning was usually more on the management aspects of the project and the ability of the firm and its partner in handling the project. Representatives from the technology institution or firm were also called in for clarifications if needed. The ICICI team could also seek clarifications from the firm or university/technology institution representatives after the

meeting. Separate meetings were sometimes also held subsequently with one or two interested board members, for further discussion if felt necessary by the board. The project was then discussed in the next Approvals Board meeting.

Project Selection Process

Apart from the feasibility and viability of the proposed project, the ICICI also evaluated projects on their potential contribution to technological development in the country. On developmental grounds and to encourage industrial research - especially to promote activity in areas of technology neglect and to promote desirable co-operation between universities, technology institutions and firms - even projects that were expected to yield adequate rather than high returns could be financed. The complex nature of the selection process is depicted in the following statement made by an ICICI project coordinator. "In selection we look at a large number of variables such as promoter, company, scientist, product, market, background and given this high complexity there is no clear model to guide us about which project to approve. So when we say 'yes' it is always some thirty percent 'no' as there are many gray areas and things may change over time in an R&D project."

The complex nature of variables considered, reasoning followed, judgements made and hunches used for selecting projects to finance is best depicted in the following statements made by ICICI project coordinators when asked specific questions related to the process of selecting specific projects for SPREAD finance. These statements include general rules of thumb as well as aspects specific to a given project. As seen in these statements, apart from the selection norms of the SPREAD program, unique features that supported a project proposal were also considered positively and build confidence in the ICICI towards financing the project. (The names of firms and universities or technology institutions mentioned have been removed to preserve confidentiality.)

"It was a unique project. They (a foundry firm) were trying new concepts in foundry Any foundry worldwide has not done it. This appealed to us The firm was a leader in the industry. Foundry has export potential in the country. So we wanted to encourage a good project for demonstration effect in the country. There was a multi-disciplinary team from the (technology institution). There were management solutions attempted also. This was the first project where we were also looking at management solutions simultaneously."

"The firm (in the machine tools industry) had a good brand image. There was no competition in their product. It was an ambitious project for them. They were technically sound but not growing. The project was clearly linked to their need - their future growth depended on it. They could not leave it. Their need was specific - such a machine was not easily available. Nobody in the country could deliver it. They were looking at larger turnover through this machine and we could help them grow. Complementary skills could come into the firm through the introduction of new technology and electronics. Also good feedback on the shop floor was possible. The promoter was a committed person with good background. He had a single project focus of attention - he was not dividing time on several projects so he could concentrate fully on this project. The (technology institution) professors are leading people in the field and were interested in the project. The professors gave new insights and a new level of technology development came up from the project for the firm."

"They (a pharmaceutical firm) gave a list of about fifteen projects and we chose ten of them to support. We chose those projects that had innovative content, adequate justification and potential market. Where several projects required the same facilities for development and the project required establishment of those facilities, we chose a representative project for appraisal. If suitable, we financed all the projects that required

those common facilities. In bulk drugs we selected all the projects while in formulations we left out one product because it was a "me too" type of product. In food projects there were a few that were not considered, as they did not fit the SPREAD financing criteria. These projects were also unique in that three institutions were already consultants to the firm before these projects were initiated. Their (firm's) scientists had already developed an excellent relationship with the institution scientists. The projects were therefore greatly facilitated by this rapport. If the firm is new to the institution then it takes more time to come to an understanding."

(This firm had earlier been financed under ICICI's Export Development Fund.) "Our Export Development Fund experience with them was good. So we gave an initial 'OK' after discussion. Then both (ICICI's Technology Group manager) and I made a visit to the firm. By then they had already decided on the institution tie-up. The institution had the facilities and the CEO (of the firm) had a good rapport with the project leader for this project (at the institution). We saw the existing product and discussed the changes. After visiting the firm we went to the institution. There the development was already on. They showed on the computer screen how the device would look and work. The benefits were discussed. We were convinced that the firm had the capability to manufacture the product and the institution had the design skills and capabilities The project worked well because the firm was very clear about what to do regarding the product and the features. They had a very good documentation system that facilitated the (technology institution) people who were clear about what they had to do. Both sides had qualified and capable people. The (technology institution) had first rate engineers and there was commitment and sincerity from both sides."

Activities Subsequent to Sanction

Once the project was sanctioned, the firm had to open a separate "no lien" bank account for the loan and had to bring in its own balance of contribution (50% or more). It also received a format for the preparation of quarterly progress reports. This format listed the technology and feasibility report based milestones and also listed issues that were peculiar to the project. It also covered the site monitoring of the project, frequency of meetings and the concurrent transfer of technology.

The project was monitored by the ICICI project coordinator through visits every six months to the company and the technology institution or university to observe the project progress and initiate corrective action in case of delay. Tripartite meetings were usually held. The firm sometimes took the initiative to come over to the ICICI to discuss their project progress and to keep the ICICI informed about problems, successes and plans. Sometimes initial reminders from ICICI were needed regarding reporting, especially for firms that were not familiar with such reporting requirements from financial institutions.

Disbursement was linked to the progress reports and an auditor's certificate for all payments made through program funds. Project delays sometimes occurred either due to negligence or due to genuine technical problems. In such cases of delay, the ICICI project coordinator visited the firm to carefully assess the reasons. If the delay was for technical reasons that occurred despite best efforts, the causes were analyzed and the firm was asked to draw out a fresh plan to prevent further delay.

At the end of the project the ICICI project coordinator visited the project site to evaluate results. The loan repayment schedule was decided in case the project was a technical success. In case of technical failure, the firm had to give a convincing representation to the ICICI requesting for the loan from ICICI to be written off, and the ICICI Approvals Board then considered the merits of the case in its next meeting.

Similarity to Venture Capital

The SPREAD program was similar to venture capital financing in that some of the technological risk was effectively underwritten by the ICICI as it could consider writing off the loan if the R&D project was a failure despite all reasonable efforts. Another similarity to venture capital financing was the high interest and involvement of the ICICI in the project. Starting from the evaluation stage, where it was involved in developing the project proposal, and going right up to the commercialization stage, the ICICI provided managerial expertise to the firm and the university or technology institution in proposing, assessing and implementing their project.

The ICICI effectively used the expertise they developed over multiple projects and through specialized training to help the firms in project management. They assisted in the formulation and structuring of the project both for capital expenses and operating costs. They also set conditions for future disbursement. They sometimes helped in the formulation of the project team and in setting up the project monitoring structure in an advisory capacity. In case the firm was contracting a technology institution for the first time, they set guidelines on the scope and type of the memorandum of understanding they should develop. In one case the ICICI even identified the customer for a firm. In another case they found a buyer firm to take up the product for commercialization when the firm that developed it could not do so. Some firms had difficulty in conducting third party inspections and ICICI helped them in this activity. Other activities that ICICI assisted in were legal documentation, identification of technical consultants, consulting fee negotiations and disbursements.

However in all these cases, the ICICI consciously avoided taking a lead role or larger role in the project. According to an ICICI coordinator, "We shift the onus on to the firm. They are the owners of the project. If we take a larger role too often, then the company will take a

lower role and then failures may be blamed on our interference. So we try to keep away and let the firm take the lead." The ICICI also acted as a technology information center, providing firms, universities and technology institutions information on technology available elsewhere in India and abroad. It also administratively facilitated the project by convening multi-organizational meetings, encouraging co-operative behavior and resolving disputes.

Results and Benefits

The ICICI initiated the SPREAD Program in 1991. It sanctioned loans to over a hundred firms and this resulted in more funds being diverted to this program than initially planned. Apart from the initial US\$ 15 million, a further US\$ 10 million that was left unutilized from the Technology Institution program was diverted to the SPREAD program to meet the relatively higher demand on the program. As loans under SPREAD finance were returnable conditional to project success, the ICICI effectively took upon itself part of the project risk and acted as a catalyst for the university - industry joint R&D activity. ICICI's expectations from these projects were not only in terms of technical and commercial success. They saw it more as a starting point for enhanced university - industry interaction. However many SPREAD projects have been commercial successes (Business Today 1993). The university-firm link has continued in many cases with the firm retaining the university scientists for consulting projects later. However the link has usually been project specific rather than of a continuous nature.

Apart from technical and commercial success, benefits from these projects included exposure of the latest industrial practice for the university or technology institution and exposure to the latest technical knowledge for the firm. The SPREAD program has therefore helped in the task of reducing the gap between the potential existing in the universities and technology institutions in India and their exploitation by Indian firms.

Conclusions

The SPREAD program represents an effective model of a successful initiative in University-Industry-Government collaboration. A diagrammatic representation of the various agencies and their interactions that supported this initiative in India is presented in Figure 1.

Part of the apparent success of the SPREAD program in meeting its objectives (Najmabadi and Lall 1995) may be due to the fact that though the Indian government took the initiative with support from the World Bank to initiate the program, it left program implementation entirely to a development financial institution that had an adequate knowledge base and appropriate skills to do so effectively (Bhatt 1993). Similar initiatives in technology finance implemented directly by government agencies in India are reported to have not met with much success possibly due to their inability to effectively handle the complex analytical and decision making task required. However, comparative research is required to effectively assess the success of such technology finance and support programs and establish the veracity of this conjecture.

Figure 1 about here

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Table 1: Structure and features of the SPREAD Program (ICICI undated)

Stated objectives:

- (a) to encourage industrial firms to substantially increase their R&D activities
- (b) to foster closer links between industry and technology institutions
- (c) to utilize the existing infrastructure in technology institutions to the fullest extent possible
- (d) to assist industrial firms in improving the cost effectiveness in R&D projects
- (e) to assist industrial firms in shortening the R&D project cycle

Benefits of program to industry.

- (a) support for projects at all stages of the R&D cycle starting from laboratory and pre-feasibility studies to prototyping and pilot plant operations
- (b) facilitating access to the large pool of scientific talent and the extensive laboratory facilities of the technology institutions in the country
- (c) help in obtaining greater mileage out of the company's R&D budget through substantial savings in capital investments in major facilities and employment of personnel
- (d) encouraging small scale industries to undertake R&D programs which they would not be in a position to do on their own
- (e) help in establishing a continuing relationship with technology institutions that can significantly expand the scope of the company's R&D activities.

Eligible projects:

- (a) development of new product or process
- (b) significant improvements in an existing product or process
- (c) scaling up of a technology developed by an institution.

Project activities eligible for funding:

- (a) pre-feasibility studies
- (b) laboratory trials
- (c) prototype building and pilot plant operations.

Project requirements:

- (a) should have feasible and quantifiable objectives,
- (b) should not take longer than 18 months to two years to complete
- (c) should envisage division of major activities between the industrial firm and the institution

Financing Mode:

- (a) The firm contributes atleast 50% of the investment
- (b) ICICI contributes the remaining requirement as a conditional loan to the firm
- (c) Loan can be written off at the discretion of the ICICI if the project fails.
- (d) Maximum assistance for a firm is Rs. 15 million
- (e) Loan component cannot exceed the net annual increase of average R&D outlay of the firm for the preceding two years.
- (f) The loan cannot be used to finance ongoing R&D projects.

Charges:

- (a) Loan charged @ 6% (concessional rate) during the project implementation
- (b) Loan charged @ 15% (commercial rate) on conclusion of the project
- (c) Loan to be repaid over upto ten years after commercialization.
- (d) Disbursement of funds will be closely coordinated with the successful achievement of benchmarks given in the project proposal and in the firm's written agreement with the ICICI.

Table 2: Details required from firm in the preliminary proposal for SPREAD finance (ICICI undated).

- 1. Name and address of the company**
- 2. Brief particulars about the company and the latest audited annual report.**
- 3. Major areas of R&D**
- 4. Brief description of R&D facilities**
- 5. Current R&D budget**
- 6. Number of persons engaged full time in R&D activities**
- 7. Major R&D achievements**
- 8. Brief particulars of R&D projects sponsored in the past by the company with institutions**
- 9. Project title**
- 10. Uses of product/process**
- 11. Innovative content**
- 12. Name and designation of the person in charge of R&D program at the company**
- 13. Technology institution with which the project is proposed to be sponsored**
- 14. Key persons at the technology institution who will be involved with the project**
- 15. Major steps involved in the R&D project.**
- 16. Break-up of major activities to be undertaken by the company and the technology institution**
- 17. Aim of the project in quantitative terms.**
- 18. Economic justification for undertaking the proposed development in terms of cost-benefit analysis.**
- 19. Brief particulars of work already carried out on the project.**
- 20. Outlay on the project (a) at company, (b) at technology institution.**
- 21. Schedule of implementation for R&D project.**
- 22. Cost of commercialization of R&D project.**
- 23. Time required for commercialization**
- 24. Expected sales from the commercial venture.**

Figure 1 The Support Structure for University-Industry-Government Interaction and Technology Collaboration in India

