World Development, 1975, Vol. 3, Nos. 11 & 12, pp. 867-876. Pergamon Press. Printed in Great Britain.

The ITINTEC System for Industrial Technology Policy in Peru*

FRANCISCO R. SAGASTI

Field Co-ordinator, STPI Project and Vice-Chairman, Board of ITINTEC, Lima, Peru

1. *Background to the emergence of ITINTEC*†

The awareness of the need to develop national science and technology policies in Peru emerged rather slowly over a period of more than ten years, although in practice there is still no widespread acceptance that they constitute a legitimate component of the development planning effort. In part this awareness was stirred by external influences, and in part by the growth and evolution of the scientific community. Of particular significance were the three seminars organized during 1966–68, at Paracas, El Bosque, and Ancón, where Peruvian scientists, executives, government officials, and military personnel met with their North American counterparts and exchanged ideas on government actions required to stimulate the growth of science and technology. Several UNESCO missions, staffed mainly with French experts, also visited the National Planning Institute and the office of the Prime Minister, lobbying for the creation of government institutions that would undertake the formulation of national science and technology policies.[1]

These efforts, and the perseverance of several high-level scientists and administrators, led to the creation of the Consejo Nacional de Investigación (National Research Council), in late 1968. The creation of this body was one of the first pieces of legislation enacted by the Revolutionary Government of the Armed Forces. This institution received substantial support from the Regional Programme for Scientific and Technological Development of the OAS, and was able to undertake a series of studies on resources for science and technology and on transfer of technology. Our knowledge of the situation in the late 1960s is derived to a large extent from these studies.[2] A summary of key facts follows.

In 1967 only 14% of the students in the higher education system were being trained in scientific or technical disciplines. The great majority, following the hispanic tradition of colonial times, were being trained in the humanities and law, with a significant percentage in the social sciences. This was in spite of the rapid expansion of the university system which grew almost fourfold between 1960 and 1970.

Thus, from 1960 to 1970, the number of university students more than tripled, reaching almost 100,000. During this significant increase, the proportion of students in the humanities, including the social sciences, went up from 38 to 47%: the relative share of students in education went up from 21 to 24%, while the percentage of students in the natural sciences diminished from 8.6 to 4.6%. The percentage of engineering students decreased from 20 to 18%, while medical students decreased from 12 to 7%. The absolute figures present a different picture in the sense that the number of engineering students, for example,

* This paper is based on an address delivered at the Interamerican Forum for Technological Development, convened by the Institute of Latin American Studies of the University of Texas at Austin, February 1975. I am grateful to I. Flit and G. Flores for their comments and suggestions.

† The acronym stands for 'Instituto de Investigación Tecnológica Industrial y Normal Técnicas'. In English I shall use 'Industrial Technology Institute'.

1. The 'institutionalization' of science and technology policies is treated in a joint paper with Isaías Flit, provisionally entitled 'A premature history of science and technology policy in Peru'.

2. See, for example, Consejo Nacional de Investigación, *Potencial científico y tecnológico del Perú* (Lima, Perú, 1974).

doubled during that period. Nevertheless, they indicate that during a phase of rapid expansion of the higher education sector, enrolment in the traditional professions increased faster than in those oriented towards technology.

From nine state universities and one private university in 1960, the number went up to 22 state and 12 private, totaling 34 universities with 253 academic programs and 336 departments (for a student population of less than 100,000). Clearly, it was almost impossible to maintain high standards in an expansion process of this kind.

In 1970 the university system in Peru spent approximately 1.8% of its total budget on research, amounting to US$1.5 million. However, many administrative and teaching tasks were allocated to the research budgets and a significant proportion was devoted to agricultural research in state-run experimentation stations attached to the universities. On average, less than US$60,000 per annum were spent by each university for research, and about US$15 per annum per student. These average figures hide wide disparities, for most of the research budgets were concentrated in half-a-dozen state universities and three or four private institutions.

To complete the picture on higher education, it is also known that around 15% of engineers who graduated between 1962 and 1966 emigrated to the United States, Canada and France, while a smaller percentage from the natural and social sciences and medicine, together amounting to about 9%, also did so. These figures indicate the lack of a solid basis of highly trained manpower on which to develop an indigenous capacity for the generation of technology. If we look at the statistics on scientific and technological activities the outlook is confirmed.

In effect, according to surveys and estimates made in 1970 by the National Research Council, there were 184 research institutions in Peru, employing a total of 2,900 workers. Of these, less than one half belonged to the category of researcher and technician, and even less worked full time in research tasks. Most of this personnel was involved in natural and exact sciences (29%), in agriculture (28%), in the medical sciences (21%), with only 10% working in the engineering field (the rest being in the social sciences). A total of about US$5.9 million were allocated for current research expenditures in 1970, with a substantially smaller amount allocated to investment expenditures. Allowing for omissions and capital investments, the total is certain not to exceed US$10 million.

Turning now to average ratios, these figures imply that there were less than 16 workers–and even less researchers–per institution, that each institution spent around US$32,100 per annum, and that each worker was allocated about US$2,000 per annum. Additional data show that the number of research projects under way exceeded 1,100, which would imply an average of 1.7 workers per project and an average allocation of US$5,200 per annum per project.

All of this gives the picture of a rather small and fragmented research system, requiring a process of concentration and rationalization of a significant influx of funds, and a substantial increase in the number of researchers. However, it must also be pointed out that engineering training in the mid-1960s, particularly at the National Engineering University, had achieved rather high standards, and that there were many professionals and scientists struggling to do research under very adverse conditions. A few 'pockets' were created, most notably in genetics, geophysics, medicine, theoretical physics, anthropology, mathematics, development economics, and a few other subjects. These groups managed by various means to survive and do high-quality work.

The situation with regard to the transfer of technology has been widely studied in several reports.[3] Here it will suffice to say that the transfer of technology in Peru, particularly via licensing agreements, had most of the defects and showed most of the abuses that have been often documented. It was clear that the importation of foreign technology did not contribute effectively to the development of indigenous technical capabilities in industry, and even less to the development of an autonomous capacity for decision-making in matters of technology.

Also the economic environment and the cumulative effect of past policies promoting import substitution was felt very clearly. Elsewhere I have given a description of the technological effects of some characteristics of the economic system, and of government economic policies for Latin American countries in

3. See, for instance, a series of eight sectoral reports on technology transfer published by the Consejo Nacional de Investigación between 1971 and 1974. A summary of early data appears in G. Oxman and F. Sagasti, *La transferencia de tecnología hacia los países del Grupo Andino* (Washington, D.C., Department of Scientific Affairs, OAS, 1972).

general.[4] These apply rather well to the Peruvian situation, for in the late 1960s we were exhausting the first phases of the 'easy' import substitution process.

The changes initiated and sustained by the Revolutionary Government of the Armed Forces have modified this situation at a fast, although uneven, pace. After the creation of the National Research Council, which has been mostly ineffective and almost a handicap to technological development, the General Law of Industries, passed in July of 1970, was the next landmark in the evolution of a policy for the development of technical capabilities in industry. Among the significant measures introduced by this law, it is worthwhile to single out a transition from the policy of import substitution industrialization, which sought to exploit backward linkages from consumer goods and light durables to intermediate and basic industry, to a policy of industrialization based on the development of basic and capital goods industries that would have both forward linkage effects (through the production of inputs for intermediate and consumer industries), and backward linkage effects (through a more intensive use of national resources). The law also sanctioned greater participation of the state in the industrialization process, not only in a promotional role, but also through entrepreneurial activities, particularly in the basic industries. With regard to ownership, the law established a system of workers' participation through the 'industrial community', a collective entity grouping all workers in each enterprise which, by using a certain percentage of net income, will gradually acquire shares and hence the right to participate in the administration and management of the enterprise. In relation to ownership, the law also stipulates the gradual transformation of foreign into mixed and national enterprises, setting limits to the percentage of foreign capital. Finally, the law establishes a system of incentives based on the priority assigned to products. Those assigned first priority are given incentives (reduction of import duties, tax exemptions on reinvestments, special credit conditions, and so on) in greater proportion than those in second or third priority.

The General Law of Industries also has several articles dealing specifically with technology matters. Two of these, articles 14 and 15, refer to the creation of ITINTEC and to the industrial technology research fund formed by allocating 2% of the net income before taxes of industrial enterprises. These two articles constitute the foundation on which the ITINTEC system of industrial research was created. There is also a clause stating that the enterprises which produce technology will be given first priority treatment with regard to incentives.

In addition to the ITINTEC system, the general laws of mining, fisheries, telecommunications contain similar clauses that direct 2% of net income before taxes (1% in the case of mining) to technological research. Unlike the case of ITINTEC, where enterprises have the first option to use the funds they generate, in these cases the money goes to a central fund. Also, during the past four years the allocations to agricultural research, health research, to marine sciences and to science and technology in general, have grown considerably, changing rather drastically the picture shown earlier for 1970.

In the area of technology transfer, Peru has created a structure of National Registry Offices (Organismos Nacionales Competentes) according to the stipulations of Decision 24 of the Andean Pact Commission. This has involved the creation of a registry of licensing agreements, changes in the organization of the industrial property office, the creation of a committee to oversee foreign investment and the transformation of foreign enterprises into mixed or local ownership, and the installation of a consultation process to screen technologies to be imported.

Summarizing the background at the time ITINTEC became active in the early 1970s, it is possible to characterize the situation as follows:

(a) Emergence of sectoral institutions under the aegis of ministries (ITINTEC in Industry, INCITEMI in mining, INICTEL in telecommunications, etc.), with stable sources of funds derived from a percentage of the net income of enterprises in the sector, and which have the mission of programming, financing, and carrying out technological research and training. The amount of funds made available through these institutions may exceed 1,000 million Peruvian soles per year (approximatelly US$25 million) by the mid-1970s. In consequence they now become the key institutions with regard to technology policy.

(b) Incapacity of the National Research Council—or for that matter of any central agency—to carry out the task of devising science and technology policies for the whole

4. F. Sagasti and M. Guerrero, *El desarrollo científico y tecnológico de América Latina* (BID/INTAL, 1974).

country. In consequence, the Council is structurally unable to perform the functions assigned to it by law, which were defined at a time when the confusion between science policy and technology policy was the rule. If the Council is to be effective, it must reorient its activities towards the promotion of scientific research, leaving the functions of formulating and implementing technology policies to the sectoral institutions that are better suited to do so. This does not imply that intersectoral co-ordination is not necessary, but rather that there are better mechanisms (for example an interministerial committee) for co-ordinating the technology policies of different sectors.

(c) Continuing isolation of the university research system from national needs. This is partly a reflection of the crisis through which the Peruvian university is passing, although the resources that could be channelled through the sectoral funds may revitalize research in the university, (provided that it is transferred to it primarily through contractual agreements). This could reduce substantially the isolation of research in universities.

(d) Initiation of the mechanisms for controlling the imports of technology, which will require substantial development before they become fully operative.

The increased sources of funds, and the orientation and training programmes instituted by the sectoral agencies in charge of technology policy, have also had the effect of increasing the availability of manpower for research tasks. Although the lack of high-level scientists, technicians, and professionals to conceive and lead research projects constitutes perhaps the major bottleneck in the system, there appears to be a 'hidden capacity' to identify, formulate, and carry out research projects, both in industry and the university, so that the shortage of qualified manpower has not proved to be as critical as was once thought.

2. *Basic features of the ITINTEC system*

Two years after the General Law of Industries established the basis for the creation of ITINTEC, the Organic Law of the institution was approved. This law established the objectives, structure, and operational mechanisms through which the ITINTEC system functions. The Board of Directors was constituted towards the end of 1972 and, after one year of transition during which most of the general policies were laid out, a new management, under the direction of Mr. Isaías Flit, took over and has been running ITINTEC ever since. Since its creation the Board has been working closely with ITINTEC executives to design the policies and policy instruments that would enable the institution to fulfil its functions.

The ITINTEC system is an attempt to deal comprehensively with the problems of industrial technology policy in an underdeveloped country. It is a multiple-function organization which operates several policy instruments to develop technological capabilities in Peruvian industry.[5]

The Organic Law of ITINTEC assigned the functions of promoting, supervising, and carrying out industrial technological research; of preparing national technical norms and standards and of improving quality control in industry; and of performing additional activities such as providing technical information for industry. As a result of the reorganization of the Ministry of Industry and Tourism in late 1974, the functions of providing technical information, documentation, and extension services for industry were expanded, and the functions of dealing with industrial property and of negotiating and registering licensing agreements were transferred to ITINTEC. During the years of operation of ITINTEC the Board of Directors has also defined complementary fields for action covering areas such as engineering and industrial design, export of technology, training of personnel for technological research, and the formulation of industrial technology policies. Furthermore, ITINTEC has also developed very close working relationships with other organizations in the industrial sector and with institutions that perform functions similar to that of ITINTEC in other sectors. In sum, ITINTEC has become the executive agency for the formulation and implementation of industrial technology policy in Peru.

In this paper I shall cover only the activities related to industrial research, although before doing so it is necessary to describe a few general principles established by the Board which govern the function of ITINTEC.

In the first place ITINTEC will use the existing capacity for technological research in enterprises, universities, and research institutions to the fullest possible extent, seeking to

5. For a general overview of the lines of action for technology policy followed by ITINTEC see *Hacia una política tecnológica nacional* (Lima: ITINTEC, 1974); I. Flit, *El Conocimiento, base común de la generación y transferencia de tecnología* (Lima: ITINTEC, 1974); and F. Sagasti (with M. Guerrero), *El desarrollo científico y tecnológico de América Latina* (Buenos Aires: BID/INTAL, 1974).

turn them into 'centres for the generation of technology'. Of particular importance are the technical capabilities of industry, which have lain dormant for many years, and which could be directed towards the identification of technical problems which require systematic and imaginative solution. This implies a belief in the existence of a 'hidden capacity' for technological research, which should be uncovered and used to enhance the technical level of Peruvian industry.

Second, in accordance with the National Development Plan, ITINTEC will decentralize its activities, establishing a nation-wide network of entities for the generation of technology. This implies not only spreading funds for research throughout the country, but also locating technology centres in various parts of the country to perform technical activities to support industry, both in the region where the centre is located, and at the national level.

Third, the promotion of a demand for local technology is one of the key principles that orients the operations of ITINTEC. This is done through the involvement, right from the beginning, of the users of the results in the formulation of technological research projects, and by forging links between users and producers of technological knowledge. This is of particular importance in the case of industrial enterprises which have remained relatively isolated from the development of technology research institutions until now. Also, the organization of a system, by means of which a certain proportion of an enterprise's net income must be spent on research, generates an incentive for the enterprise to look at its technical problems more closely, and hence an increased demand for local technology and technological services.

Other principles which govern the activity of ITINTEC include the need to intervene directly and actively in the process of importation of technology, seeking to link this process with the production of domestic technology Given that the great majority of the technology used by industry comes from abroad, this activity is of great importance for the definition of research projects that will enable the enterprises to adapt, modify, and absorb the technologies imported from abroad. This would lead to a progressive participation of local technological institutions in the evaluation of imported technology, the disaggregation of the technological package, and the selection of the most appropriate technologies to specific conditions in the country. Also, whenever possible, ITINTEC will seek to provide direct assistance to small and medium-scale enterprises, which lack the technical personnel to perform research tasks.

Perforce, ITINTEC will have to function as an 'invisible university' for training personnel for industrial technological research. Enterprises and institutions carrying out research projects within the ITINTEC system are encouraged to include students from the universities in their projects so that they participate actively in the research project and 'learn while doing'. This also implies the need for acting as an agent to relate high-level specialized professionals with industries that might require their services for a specific problem.

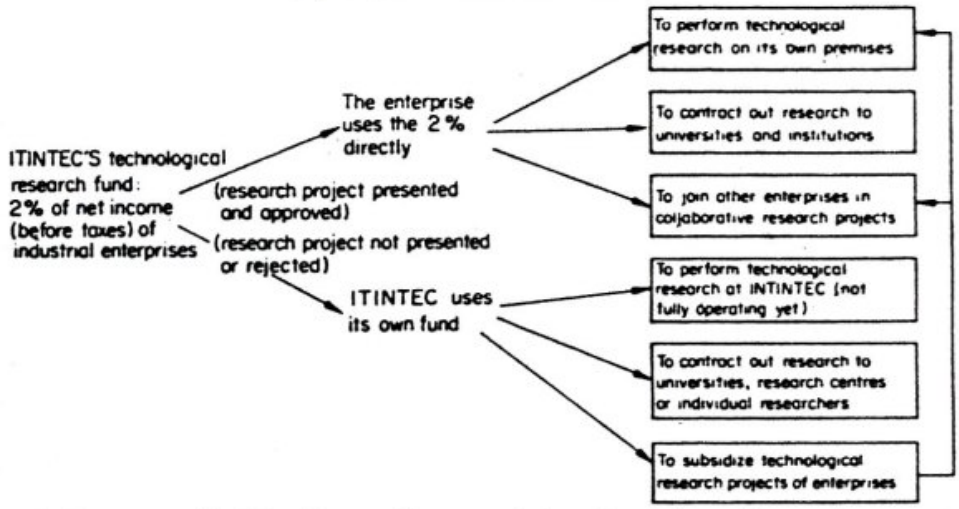
Finally, given the magnitude of the task involved, and the dangers of growing too fast, ITINTEC will expand its activities gradually, carefully balancing short-term achievements with long-term objectives. ITINTEC will also avoid growing excessively with a centralized management structure, and it may eventually turn into a 'conglomerate' which covers a variety of activities related to industrial technology policy. In that sense what is sought is a balance between comprehensiveness in the formulation and implementation of industrial technology policies, and the efficiency of a small organization with specific functions to perform.

3. *Industrial technological research in ITINTEC*

An underdeveloped country has to give the concept of 'research' the content that fits its own situation. For the Peruvian case, Isaías Flit, the Director General of ITINTEC, has defined industrial technological research as 'the application of imagination with scientific rigour to the solution of a concrete technical problem in industry'. In this way, the spectrum of technological activities covered is expanded greatly, and the usual discussions on applied versus basic research are avoided. For example, if the solution of a concrete technical problem in industry requires the performance of research tasks of a fundamental nature, they would be included within the scope of ITINTEC. This definition also puts emphasis on the source of research projects, namely the concrete technical problems of industry, and on the two key components of research: imagination and scientific rigour.

Bearing this definition in mind, it is possible to understand better the orientation of industrial research activities of ITINTEC. Fig. 1 summarizes the way in which funds can be used within the ITINTEC system of industrial technological research. Every industrial enterprise is

Fig. 1. Uses of ITINTEC's research fund.



required to put aside 2% of its net income before taxes for the performance of technological research. The enterprise has the first option to use the funds if it decides to present a research project and ITINTEC approves it. The enterprise can perform the research on its own premises if it has the manpower and equipment necessary, or it can contract out the research to some other entity (primarily universities). In this case the enterprise and the research centre sign an agreement whose general terms and conditions are specified by ITINTEC in a model contract. If the enterprise decides not to present a research project, or if the project presented is not approved, then the 2% of net income before taxes has to be deposited at the National Bank in a special account in the name of the research fund of ITINTEC.

With the funds gathered from enterprises which do not present projects, or whose projects are rejected, ITINTEC can carry out its own projects, it can contract out projects with universities and other centres, or it can subsidize research projects that are being carried out by enterprises. In this latter case, preference is given to enterprises undertaking joint research in collaboration with others, and to medium and small enterprises that have worthwhile research projects but whose funds are not sufficient.

To guide enterprises in the formulation of research projects, ITINTEC has prepared a manual specifying the structure and content of the proposals to be presented by industries, universities, or any other entities. The proposals go through an evaluation process by the technical staff and, depending on the amount of funds involved, they are either approved by the Director General or by the Board of ITINTEC. In addition to requesting research projects from the enterprises, ITINTEC also asks individual researchers and research organizations to submit proposals which could be financed out of ITINTEC's fund. Once a project is approved, a contract is signed between ITINTEC and the entity that will carry it out. It specifies the terms and conditions of the agreement, establishes a detailed programme of expenditures, and defines reporting procedures. The projects are monitored by ITINTEC's technical staff, the progress of the project followed and final results evaluated upon completion.

ITINTEC's direct research activities have not been fully implemented yet, although there is a plan for creating several 'technology centres' throughout the country, in which ITINTEC would carry out its own projects. An intermediate solution is now under consideration, by means of which ITINTEC personnel would do research using the equipment of other organizations or enterprises.

The system outlined in the preceding paragraphs has several characteristics that make it rather interesting for the purpose of promoting the development of industrial technological capabilities in less developed countries.

First, it provides a 'protected market' for research and development. By specifying that funds can only be used to finance research projects (and by making ITINTEC the guarantor that funds are used for this sole purpose) it generates an effective demand for technological

research. Given that enterprises face the option of using the funds for technological research, or turning them over to ITINTEC, there is an incentive to examine the technological problems of the enterprise. If the management is already convinced of the value of research this would be seen as an additional encouragement; and if management is indifferent to technological problems, this may generate a concern for improving technical capabilities.

Second, a decentralized system is established whereby the definition of research projects is spread throughout industry, avoiding excessive centralization in the definition of research priorities and projects. The presumption is that industrial enterprises know better than anybody else their own problems and are able to formulate research projects which truly respond to their own technological needs. Together with the guidelines for the preparation and presentation of projects, enterprises are further informed, through a set of criteria, as to what constitutes a worthwhile project from the point of view of ITINTEC. During the phases preceding the formal presentation, and sometimes even after this, there is a continuous dialogue between ITINTEC staff and enterprise management, in order to arrive at the definition of research projects which could be approved by ITINTEC. The main concern is to give enterprises as much assistance as possible so that they can develop their own capacity for the identification, preparation, and execution of research projects or, alternatively, to develop their own capacity for identifying and defining terms of reference so that the projects can be carried out by specialized research agencies. All of this implies that the basis for the activities of ITINTEC is the research project, and that wide-ranging open-ended programmes, preliminary ideas, and unstructured research programmes with no clear contribution to enterprise and national objectives are not accepted. The performance of technological research projects, or the capacity for specifying terms of reference for other entities, would lead to and increase in the technology absorption capcity of industry. To allow for projects that last more than one year, the ITINTEC system provides that an enterprise can allocate its 2% for up to five consecutive years for the realization of a particular project.

Central to the operation of the ITINTEC research system is the idea that contractual arrangements for specific projects should be used, rather than the granting of subsidies or the allocating of funds to open-ended research projects. The idea is to develop the habit of 'contract research by making enterprises pay for a specific service, and therefore become concerned about the results they get. On the other hand, this would also force the research institutions to deliver the goods in accordance with the objectives, terms, and conditions specified in the research project and the contract. This is of particular importance in view of the fact that the 2% system provides a stable source of funds, free from budgetary negotiations, and which could perpetuate a situation where irrelevant research is supported indefinitely.

Another key characteristic of the ITINTEC system is that the state participates actively in the support of industrial research on a decentralized basis. In effect, the 2% is computed before taxes and therefore the state is foregoing the income it would have obtained if the 2% were computed after taxes. In some cases, for the relatively large enterprises, this could reach almost one half of the 2%. Together with this financial support, there is the right of the state to participate in the use of equipment and materials, and in the results generated by the projects. To this end, ITINTEC follows the policy of avoiding the duplication of expensive research equipment by orienting research projects of the same type to a particular centre, or by asking that equipment be put at the disposal of other enterprises or research centres which require it. ITINTEC carries an inventory of equipment purchased with the 2% fund as a means of putting into practice this policy.

The situation is more complicated with regard to the ownership of results (primarily patents), and in this respect ITINTEC has followed a very flexible policy, treating each research project on its own merits. Clearly, there may be some instances where enterprises that have obtained worthwhile results should derive some advantage over their competitors; but on the other hand, there might be cases in which the knowledge produced is of too great importance to be used by one entity alone, particularly where research projects are carried out by universities and specialized research institutions. This issue also has implications with regard to the financial returns to the results of research activities, and here again, ITINTEC follows a flexible policy, so that royalties might be shared in various proportions by ITINTEC and the entities carrying out the research.

The existence of a research fund directly at the disposal of ITINTEC provides the institution with the opportunity to reallocate funds for technological research in accordance with

the needs of industrial development. In particular, this allows ITINTEC to fill the gaps where existing enterprises do not carry out technological research activities. In this respect, ITINTEC has developed, in close co-ordination with the sectoral planning office of the Ministry of Industry and Tourism, approximately 50 profiles of research projects on which proposals have been requested from universities and research centres. These projects refer to natural resources available in the country, to areas where new investments are planned, to specific problems which require urgent solutions, and to the development of research projects necessary to provide a technical infrastructure for industry as a whole.

The ITINTEC system of industrial technological research provides for widespread inputs into the process of defining priorities for industrial research. The sources of priorities and of research projects in ITINTEC are the following:

(a) projects presented by enterprises, which respond to their specific technical needs;

(b) projects developed jointly with the sectoral planning office of the Ministry of Industry and Tourism, or with the planning offices of other ministries, which respond to the needs of national development;

(c) proposals by universities, research institutes, or individual researchers, which respond to the opportunities that they see to exploit economically a particular line of research;

(d) projects that arise out of specific short-run problems and which must be solved rapidly by a contingency technology research project; these arise out of specific demands of government agencies as a result of urgent problems;

(e) projects that emerge out of ITINTEC's own planning effort; these respond to anticipated technological problems in areas where ITINTEC must intervene;

(f) projects arising out of anticipated technological problems that international commitments may impose on Peruvian industry, such as the case of industrial programming in the Andean Pact;

(g) projects arising out of basic research results which show an economic potential for their application.

This scheme ensures diversification of the sources of research proposals and of research priorities. It is ITINTEC's task, and particularly that of its Board of Directors and Director General, to harmonize and consolidate projects arising out of these sources into a coherent whole, with the aims of attaining the objectives of developing technological capabilities in industry and of acquiring a capacity for autonomous decision-making in matters of technology.

4. *A preliminary appraisal of the ITINTEC industrial research system*

In the first stage of the development of ITINTEC, (between the General Law of Industries in the middle of 1970 and the time the new administration took over in late 1973) a total of 108 projects were submitted by enterprises, even in the absence of guidelines from ITINTEC. Of these, 54 were approved and most of them have been completed by now. In addition, three large research projects were generated by ITINTEC and contracted out to universities. These preliminary projects showed that it was feasible to operate the ITINTEC research system and pointed out several problems and deficiencies which are being corrected.

The first organized drive to generate research projects by industry and to develop ITINTEC's own portfolio of projects began in late 1973. The manual for the preparation and submission of research projects was published and given wide dissemination in January 1974, and the deadline for presenting research proposals was April 1. Response was enthusiastic, aided by several seminars conducted by ITINTEC's staff, Board members, and with the participation of the Minister of Industry and Tourism. A total of 189 project proposals were presented, amounting approximately to 350 million soles (approximately US$8.6 million). Industrial enterprises presented 160 projects for a total of 318 million soles, 27 projects were presented by research centres for a total of 30 million soles and two other projects were presented by individual researchers. The projects were distributed by field as shown in Table 1, the majority being in the food-processing and tobacco industries.[6]

Of the 160 projects presented by enterprises, 12 were withdrawn and 89 were approved by ITINTEC, corresponding to approximately 142 million soles. The procedure established for approvals gave the Director General discretionary power over projects, or groups of projects, which did not exceed 1.5 million soles, the rest being approved by the Board of

6. For the 1975 campaign, 91 projects had been presented by 30 April, for a total of 314 million soles. About 90% of these projects were presented by industrial enterprises.

Table 1. *Industrial technological research projects, 1974*

Project areas	Projects presented		Projects authorized			
			Number		Amounts	
	Number	Percentage	Number	Percentage	'000 Soles	Percentage
Food, beverages & tobacco	42	26.3	20	22.5	32,414	22.8
Textiles	15	9.4	11	12.4	12,456	8.8
Pharmaceutical and cosmetics	3	1.9	1	1.1	152	0.1
Metal-mechanic	28	17.5	20	22.5	53,563	37.7
Rubber, leather and plastics	12	7.5	10	11.2	15,133	10.7
Wood and cellulose products	4	2.5	2	2.2	2,087	1.5
Chemical products	19	11.9	11	12.4	10,725	7.5
Non-metallic mineral products	14	8.7	7	7.9	9,189	6.5
Machinery, equipment, and electric and electronical products	9	5.6	4	4.5	5,287	3.7
Miscellaneous	14	8.7	3	3.3	1,059	0.7
TOTAL	160	100.00	89	100.00	142,065	100.00

Directors. Table 1 gives a breakdown of the projects that were actually approved. For practically all of these, the respective contracts have been signed and the research tasks have begun. The average lifetime of a project is about 21 months, although there are wide variations.

It is too early yet to evaluate how these projects are being carried out and whether the results obtained justify the investment. However, given the lack of research tradition in Peruvian industry, ITINTEC views the projects of the first few years as part of a learning process, in which both the enterprises and ITINTEC will learn from their own experiences and from each other. In this sense, certain inefficiencies and mistakes must be tolerated in the early projects carried out by a particular enterprise. Through this process ITINTEC will also find out the type of assistance needed by industry and will be able to orient its technical services in this direction.[7]

The process of monitoring the research projects under way has already begun, and early findings confirm, as the first batch of 54 projects did, that the 'hidden capacity' for technological research can be made effective for the performance of technological activities of direct relevance to industrial needs.

With regard to its own research portfolio, through a process of consultation with the planning office of the Ministry of Industry and Tourism and through discussions with the research community, a total of 48 project profiles have been identified. These profiles describe the objectives of the research, its main characteristics, and give rough estimates of manpower needs, time required for completion and total cost. The project profiles have been distributed to research institutions and specific proposals have been requested from them. At present the rate of response is satisfactory, and in the three months that the profiles have been circulating among the research community more than 25 proposals have been received, the majority from university research centres.

Once the system is stabilized, it is expected that about 100 research projects will be presented to ITINTEC every year, and that around 20 projects will be defined and carried out by ITINTEC. The latter would increase once the 'Technology Centres' become operational. It is also expected that, as the learning process goes on, a smaller number of projects will be rejected.

This raises the question of the absorption capacity of the industrial research community to cope with a tenfold increase in available

7. Since ITINTEC's establishment approximately 300 different enterprises have submitted research projects. Of these about 100 enterprises have presented projects more than once.

funds compared to the level of 1970. In this respect, it is important to recall the definition of research given at the beginning of the preceding section. If the traditional conception of industrial technological research is maintained, it is clear that the high-level manpower needed to direct the projects will take time to develop. If the wider definition—more in accordance with our present technological situation—is accepted, there are a large number of professionals who can participate actively in the system. In conjunction with the training activities of ITINTEC and with the learning effects of carrying out research projects, it is expected that the shortage of qualified manpower will not become the acute bottleneck that it may appear to be at first.

Several problem areas have emerged which merit some attention in this preliminary evaluation. First, the work involved in establishing a system of the nature and magnitude of ITINTEC imposes great strain on the administrative and political capabilities of the executives. The core group of trained professionals who took up policy and administrative positions in ITINTEC have been under great pressure from several fronts. Part of the professional staff of the organization found it difficult to get accustomed to the philosophy and rhythm of the work imposed. However, a remarkable degree of cohesion has been achieved among the professionals and it is not unusual to see them working late and devoting their spare time to ITINTEC-related activities, which is not common for an institution in the public sector. Pressures have also been felt from enterprises to provide technical assistance, and particularly from the government bureaucracy, which finds it difficult to accept the flexible ways in which ITINTEC must operate.

A second difficulty, which is inherent in the fixed 2% allocation, is that there is a bias in favour of the relatively large enterprises whose research funds exceed the minimal critical volume required to support a research team. There are several possible solutions to this bias, and for the time being the policy is to use the funds at the disposal of ITINTEC to offset this imbalance. Other solutions, such as graduating the level of the allocation according to the size of net income, would be too cumbersome to operate.

In terms of the formulation and presentation of research projects, difficulties have emerged in the efforts to introduce the concept of contract research, with the project as the basic unit of analysis. This requires an educational process and continuous dialogue with ITINTEC's technical staff. The demands imposed by this consultation process have been heavy and rather difficult to handle with the relatively small number of professionals (about 40) who work in the Technology Division. On the other hand, a rapid expansion of professional staff would not permit maintanence of the conceptual orientation and cohesion which is necessary to disseminate ITINTEC's philosophy of industrial technological research. This also has implications for project monitoring.

Serious problems with regard to the property of results and to the use of equipment purchased with the 2% funds have not arisen as yet, although the relevant policies for dealing with a variety of situations are now under consideration.

The need to implement as soon as possible a network of technology centres that would enable ITINTEC to perform its own research activities and provide services to industry is being examined closely. Feasibility studies are now under way for the establishment of at least four technology centres throughout the country, and it is expected that the first will start operations in 1977. Parallel with the feasibility studies, a search for highly-trained personnel is under way to staff the centres.

5. *Concluding remarks*

This paper has presented a Peruvian case study of the formulation and implementation of industrial technology policies, through the development of ITINTEC.

It is necessary to stress that the paper presents only a partial view of ITINTEC. It does not cover activities related to technical norms and standards, quality control, licensing agreements, industrial property, information and extension services, industrial design, and so on. Some of these have been fully implemented, others are now under way, and others are at the policy formulation stage. Nevertheless, they constitute, from the point of view of ITINTEC, a coherent whole on which action will be taken when the time comes within the framework of a long-range institutional development plan.