



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

08645

Distr.
LIMITED

UNIDO/EX.64
18 December 1978

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

ENGLISH

THE COMMERCIALIZATION OF RESEARCH RESULTS *

prepared for the

Joint UNDP/UNIDO Evaluation Study
of Industrial Research and
Service Institutes

by

Joaquin Cordua **

* The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

** Consultant, INFINCO, Chile.

id.78-8701

C O N T E N T S

	<u>Page</u>
INTRODUCTION	1
COMMERCIALIZATION OF RESEARCH PRODUCTS IN A RESTRICTIVE SENSE	2
COMMERCIALIZATION OF THE PRODUCTS OF RESEARCH TAKEN IN A WIDE SENSE	6
THE IMPORTANCE OF TECHNO-ECONOMICAL CAPACITY IN IRSI	8
TRANSFER OF TECHNOLOGY	9
FINANCING	10
THE MECHANISMS OF COMMERCIALIZATION	10
SERVICES NEEDED FOR TECHNICAL INNOVATION	12
ROLE OF INTERMEDIATE INSTITUTIONS AS A LINK BETWEEN IRSI AND INDUSTRIAL ENTERPRISES	13
TECHNOLOGY DEVELOPMENT CORPORATIONS	16
GOVERNMENT ACTIONS	19
CONCLUSIONS	23

INTRODUCTION.

The subject of commercialization of research results can be approached in a restrictive way, limiting the analysis to problems derived from the sale of technologies entirely created by IRSI. The process usually starts with the creation of a new technical knowledge, it follows with a stage of identification of the practical applications and ends with the commercialization of the newly created knowledge.

A wider approach leads us to examine the entire field of the sale of technologies by IRSI, including those developed locally and those obtained from abroad; those that have been generated by the IRSI's own initiative and the ones created according to agreements with external users.

Here, the first approach will be dealt with only briefly, since the second one appears as the most relevant for developing countries.

COMMERCIALIZATION OF THE RESEARCH PRODUCT IN A RESTRICTIVE SENSE.

Commercialization of research in the restrictive sense mentioned corresponds basically to the "push approach" in the process of incorporating technology to the productive sector. This process starts with the new knowledge created in laboratories and pilot plants. A second step would be either to convince the existing enterprises of the advantages granted by its utilization or to organize new enterprises in order to exploit the newly created technologies.

Undoubtedly this approach is a possible way to incorporate technology into industry. Besides, it is attractive for many researchers, since it gives IRSI the responsibility in selecting subjects and orienting the work. This eliminates the troublesome process of harmonization of objectives between the Institute and the external sponsor of the project.

From another viewpoint, some utilization of the push approach can be important, since it is possible that through it, technical innovations not previously envisaged by the enterprises are provided. In this context, this approach is an important element of advanced scientific technological systems, which is reflected in an increasing number of special institutions devoted to the practical utilization of research results. However, it must be noted that this type of commercialization of technology implies pre-requisites that are rarely found

In developing countries. One of such pre-requisites is the availability in IRSI of personnel with sufficient knowledge and practical experience in the industrial field, giving them the ability to create technologies more attractive than the imported ones. This personnel will often have to work with no orientation from the user. Another pre-requisite is the existence within the industries of a strong motivation to introduce technologies generated in local sources, so that they are willing to accept the greater uncertainties associated to the use of technologies not yet proved at the industrial scale.

Obviously the Government could stimulate a greater demand of local technology from the industries, for instance by applying schemes of preferential financment, tax reductions, and other similar measures. However, there is evidence showing that, in general, the measures meant to promote and orient technological demands are effective only when they coincide with the predisposition of the entrepreneur. It must be remembered that while in most projects the technology used has a decisive influence on their successful achievement, its cost represents only a low percentage of the total investment.

Technology markets are characterized in developing countries by a very weak spontaneous demand from the enterprises. Such weakness results from a set of factors that vary from one country to another. Among these factors, the following are frequently found:

- a) Great instability of the local economic policies. This leads the enterprises to work with a very short time horizon, generally inferior to the term required by a technological project to be fruitful.
- b) There is no effective competition impelling the enterprise to improve the quality of its products and to reduce costs through technical change.
- c) The enterprises can act upon other factors, different from the improvement of their technologies, which may have a greater effect upon their profits and through which they can reach their remaining objectives. Among these factors we can mention the obtention of preferential financing, protection through Customs duties, officially fixed prices, benefits derived from high inflation rates, etc.

Under the conditions just mentioned, the lack of interest of entrepreneurs in technology may be the logical response rather than the expression of a poor management.

For these reasons, technological institutions must be carefully designed in developing countries. The great need for technology of their industrial sectors must not be mistaken as an expression of their actual demand.

Another obstacle that must be faced by technology originated in local research is competition from the varied span of technologies offered by foreign countries.

The reasons why foreign technologies are usually more appealing to the enterprises than local ones are:

- a) Foreign technologies have generally been proved at the industrial level. This reduces risks and the costs in time and money associated to the first industrial application of a given technology.
- b) In reduced markets, the total cost of imported industrial technology is often lower than that of the development of a local one; should a license be involved, it can be paid after the production has been started and in relation to the real volume of production.
- c) When buying technology from a producer, he can also provide technical assistance for starting production and for the commercialization of the product.

When the process of selecting and negotiating technologies from abroad has been well done, the advantages mentioned often surpass those of locally developed technologies. Nevertheless, the utilization of locally developed technologies has some advantages among which we can remark: a better adequation of the technologies to the characteristics of the medium; a greater independence and the prestige associated to its utilization as well as the possibility of selling it to other producers.

COMMERCIALIZATION OF THE PRODUCTS OF RESEARCH TAKEN IN A WIDE SENSE

Under the conditions described, an IRSI still in the stage of earning confidence of industries and of creating an actual demand for its services -as is the case in most Institutes of developing countries- should not devote most of its efforts to research and to the development of new technologies for its subsequent commercialization. In our opinion, this effort should only represent a small percentage of its program. Its contribution to the productive sector should principally consist of the "pull approach", that is to start from the problem or opportunities presented by the enterprises and to attempt to work them up jointly with the enterprise, always using the shorter and less costly way available.

In some occasions, this approach will include research and development of technology (hopefully oriented and programmed in accordance with the user) but, in most cases, the solution will be to buy technology abroad. In the latter case, IRSI should devote its efforts to help the user in the stages of search, selection and adaptation of technology.

In each case of technology transfer IRSI will try to disaggregate as much as possible the technologic elements involved in the solution, compatible with the time available and the technical capacity of the country. This will allow to improve the degree of adaptation to the national conditions and will provide greater opportunities of participation for the local sources of technology.

The accomplishment of a large number of increasingly complex technology transfers will give IRSI the experience necessary to undertake more ambitious creative tasks, and will also make them more reliable to the industries.

The main contribution that IRSI can provide to enterprises will lie therefore in an intermediate area between R & D services and the planning and execution of industrial projects as done by engineering enterprises. This intermediate area includes activities such as:

- Venture analysis, consisting of market studies and a survey of the technical, financial and economical aspects of new projects which, as a whole, allow to make an investment decision.
- Comparison of alternative production processes from a technical and economical viewpoint.
- Search for, evaluation and selection of technologies.
- Adaptation of processes and products to changes in scale, in cost factors, in specifications of the final product and substitution of raw materials.

Most IRSIS of developing countries do not pay the necessary attention to this type of requirements, but overemphasize the sole technological aspects of industrial problems. This is mainly due to the difficulties encountered by IRSI as to attract and retain professionals experienced in industry and with a good technico-economical training. Such specialists are scarce in

developing countries and are seldom represented to a sufficient extent in the staff of the Institutes. The training of their personnel is predominantly technological and their experience is mostly university.

The lack of experience in industrial work of the personnel is a serious drawback for the commercialization of IRSI's services, since most managers of enterprises tend to rely only on the judgment of people that have been successful in practical activities.

THE IMPORTANCE OF TECHNO-ECONOMICAL CAPACITY IN IRSI.

A balanced composition of its personnel constitutes a key factor for IRSI to get good results in technology commercialization. Therefore, the Institutes need specialists with good training and with practical experience both in technology and in economic and managerial techniques, including enterprise diagnosis, market analysis, project evaluation and venture analysis. Such a group will be able to reach a clear understanding of the objectives, problems and resources of an individual enterprise. In this respect it must be considered that each individual enterprise constitutes a different situation which must be clearly envisaged in order to understand the motivations of the manager, how he operates his organization, and the market, financial and personnel limitations he has to face. A project of technical

change requires a very broad analysis, since the manager usually considers it as a total new venture, not only in its technologic aspects but mainly from the viewpoint of the overall costs and profits it will originate.

On the other hand, having a group in IRSI with a good command of economic and market analysis can be a very valuable help in the selection of projects, guiding the Institute towards the areas of greater potentiality for an effective application of technologies.

TRANSFER OF TECHNOLOGY.

The acceptance of technology transfer as a preferential field of work may meet some resistance in IRSI. On the one hand, it may appear as an activity of less prestige than that of R & D. On the other hand, IRSI has normally considered the creation of technologies required by local industries as its primary task and has visualized the transfer of technology as a competitive process which is responsible to a great extent for the fact that the local demand is not more oriented towards national sources of technologies.

FINANCING.

The easiest way to ensure that IRSI's work is useful for industry is to make the Institute responsible towards the productive sector. This can be specially achieved when a substantial part of the financing originates from payments done by users of IRSI's services.

When financing through sales of services is small and the Government has to provide for a large part of the budget, this contribution should not be given as a subvention to the Institute itself but rather as an assignment for the execution of specific industrial projects or as contracts to execute projects of general benefit to the productive sector which, due to their amplitude or too long terms, are not appointed by individual enterprises.

THE MECHANISMS OF COMMERCIALIZATION.

Although it is obvious that technologies will favor the community only once they have been incorporated to the production processes, and it is also evident that spontaneous demand from enterprises is very weak, it is surprising that IRSI has devoted so little attention to the problem of commercialization of technology. The mechanism for promoting a larger utilization of the technical capacity of the Institutes should be further studied.

To overcome the present isolation of IRSI from industry, a more aggressive attitude should be adopted, taking advantage of every opportunities to establish direct contacts with enterprises. In the sale of technology, a face-to-face contact is far more efficient than publications or conferences. Through direct contact, the management of the enterprise has a feeling of exclusiveness which promises advantages upon its competitors.

For IRSI the most difficult period in the commercialization of its services is the initial one, when it lacks a set of successful cases to show to its potential clients. Under such circumstances, intensive programs of visits to the enterprises of the area may be advisable. In this modality, high costs and a too long delay in creating a positive image of the Institute face to industry are the principal drawbacks. This type of approach lacks the multiplier which characterizes the processes of diffusion of innovations, where the new contacts generally correspond to the most receptive industrialists or to those who are already aware of the advantages that the innovation implies.

The most favorable aspect of the door-to-door contact is its simplicity, which allows to identify the first set of clients of the institute, to shift later to a system of contacts through reference, generated by the clients who are satisfied with the services rendered.

SERVICES NEEDED FOR TECHNICAL INNOVATION.

The successful incorporation of a new technology to industry normally requires the utilization of the following services:

- a) Market studies, including the selection of the most adequate systems for the commercialization of the new products and services.
- b) Supply of the technological knowledge required for production.
- c) Sources of financemnt willing to assume the higher risks implied by innovative projects.
- d) Engineering services both for the design work and for construction of equipments and installation.
- e) Services of training and technical assistance.

It has been observed that the customer is more willing to undertake innovations whenever they are presented as a coordinate "package". Therefore, the convenience for IRSI to establish agreements with financial, engineering or other institutions, which will allow to grant the manager all the services needed to accomplish the innovation that he is considering.

ROLE OF INTERMEDIATE INSTITUTIONS AS A LINK BETWEEN IRSI AND INDUSTRIAL ENTERPRISES.

The major factor that limits a greater use of technical knowledge in industry is not the availability of technologies but in the limited number of already identified opportunities for technical change at the plant level.

For the identification of these opportunities, it is very important that a relation of confidence exists between the enterprise and a technical group with good knowledge of the specific problems and opportunities of that enterprise. Another favorable factor, already mentioned, is that not only technology is offered to the enterprise but the whole set of services that an innovation project requires.

Once the described situations have been visualized, IRSI's contribution to industry can be increased when they do not restrain themselves to direct relation with clients but also consider the utilization of various intermediate institutions. For this purpose, the following types of institutions should be considered:

- Engineering firms
- Consultants
- Institutions for technical assistance
- Manufacturers of capital goods
- Firms playing a leading role in a given industrial branch.

The function of the intermediary is to adapt IRSI's technologies to the specific requirements of the user and to provide these technologies, usually jointly with other services.

The action of an intermediary is specially useful in the following cases:

- a) When the enterprise lacks technological capacity and appoints a consultant or an engineering firm for the coordination of the project as a whole.
- b) When IRSI is only competent in a specialized technology and the economic, financial and market studies have to be commissioned from another institution.
- c) When there exists a number of enterprises of small or medium size dispersed throughout a large territory requiring a decentralized service.

The intermediate institutions can then achieve important functions, namely, to orient the enterprise about the sources of technological services available; in turn, they can advise IRSI on the specific requirements of the industrial sector within their range.

In the scheme under consideration, IRSI benefits itself through the utilization of already existing professional connections and widens the coverage of the industrial sector that could attain with its own staff.

The cooperation with private consulting and engineering firms also permits to meet the frequent criticism that IRSE competes unfairly by receiving government subventions.

When the intermediary is a manufacturer of capital goods or a leading firm in its sector, a faster diffusion of IRSI's technology is achieved. It also allows a better assistance to the receiver of technology in solving his problems in the areas of production, marketing and training of personnel.

An interesting case of intermediation with small and medium size enterprises, is the creation of a Division for Technical Cooperation in the National Training Service of Colombia (SENA). SENA, whose centers cover the whole Colombian territory, plans to achieve wide diffusion of the technologies developed by IRSI, through its training and technical assistance programs.

In order to formalize the relationship between IRSI and the intermediary institutions, the different types of existing contracts and agreements for cooperation among technical institutions can be used. Nevertheless, it is convenient that IRSI develop standardized forms that apply to the specific problems of payment, propriety of technology, responsibilities, etc., that are peculiar to this relationship.

TECHNOLOGY DEVELOPMENT CORPORATIONS (T.D.C.)

The main objective of T.D.C. is to further develop research results and to sell them to industrial enterprises.

There are different organizations setups for T.D.C.:

- As a branch organization of an IRSI.
- As a joint venture of an IRSI and a development promotion organization (a governmental agency or a development bank).
- As an independent institution created by the government.

To perform their role, T.D.C. may use their own technical resources or rely on outside expertise. The following are the most important functions of T.D.C.:

- a) To search for, to evaluate, and to select new technologies, doing the necessary market research and techno-economic feasibility studies.
- b) To further develop and adapt technologies for potential users.
- c) To promote and sell technologies.
- d) To assist industry in the implementation phase of innovation projects.
- e) To administer a special loan scheme with low interest rates for firms that have no access to venture capital on reasonable terms.
- f) To provide equity capital for new technology-based enterprises.

The last two functions are important because the financing of technical innovation is a highly specialized and risky operation -normally not performed by ordinary financial institutions. A public fund sharing the risks of the operations can significantly improve the attitude of industries to technical innovation.

A T.D.C. should closely cooperate with IRSI, with consulting and engineering firms and with universities, in order to fulfill better its functions without necessarily duplicating existing capacities.

Notwithstanding the previous statements, there are some important limitations to the role that T.D.C. can play in not fully developed technological markets. The main limitations, some of which have been already analyzed, are:

- a) Local enterprises frequently lack confidence in the capacity of national institutions to generate new technologies and are specially reluctant in using technologies that have not been tested in production.
- b) The cost of developing new technologies is relatively high for small industrial markets.
- c) It takes a long time to create new technologies when considering the general instability of developing countries.

- d) In many cases, Imported technologies are more convenient in terms of cost, availability and guarantees.
- e) It is difficult for government agencies to hire and retain for T.D.C., specialists with broad industrial experience.

The above mentioned problems, that are intrinsic to the "push approach" in the process of incorporating technology, indicate that a careful evaluation should precede the creation of a T.D.C. in a developing country.

GOVERNMENT ACTIONS.

Though technical innovations are probably one of the most risky private investments, they often generate high overall economic growth. The private benefit/cost ratio of an industrial innovation is usually smaller than that corresponding to the economy as a whole. The recognition of this situation leads to a general acceptance of a direct government support for the associated costs, such as those originated by the generation, adaptation and diffusion of technical knowledge. The main remaining questions in this matter are related to the level of direct government support and how it should be provided.

One possibility is that the government supplies a large part of IRSI's budget and that it also defines its most important programs and projects, including the definition of priorities in the field of technical innovation. The main inconvenience of this approach is the tendency to take away from individual enterprises the responsibility of making a decision about which projects are more likely to generate profit.

It is my point of view that a better alternative is that the individual firms be free to select their innovation projects and sources of technology, and that the government limits its action to the support of projects that show enough market and profit potentiality.

It should be remembered that in an innovation process the availability of a new technology represents only the first phase, which must be followed by its successful adaptation to manufacturing, and by the marketing and distribution of the products to customers. The whole innovation process is practically indivisible and its success depends largely on continuity, that can be better achieved through an early and active involvement of the interested enterprise. IRSI's role should be to support and complement what is done by the industrial firm.

Government support to innovation projects in this alternative, can take the form of tax incentives and direct grants to individual firms, in proportion to the risk of the project and to the expected return to the economy. In most cases, the public share should not exceed 50% of the total cost.

In addition to the financing of individual projects there are different ways in which government can contribute from outside to industrial efficiency and to a stronger demand for industrial technology. For instance, it can promote competitive pressure, eliminate restrictive practices, stimulate greater investment and take actions to reduce uncertainty. Although decisions in most of these areas are determined by national goals, broader than the scope of the technology policies, an attempt to estimate their impact in the rate and direction of technical change is highly convenient.

Trade and Tariff Policy.

Many developing countries have attempted to base their industrialization processes in an import substitution policy. With this aim, excessively high tariff barriers have been established and maintained for a too long time. This has reduced competition among local products and lowered the interest of national industry in technology.

Besides, due to high inflation rates an overvaluation of national currency is frequent, making the export of industrial products difficult and reducing the cost of imported technologies. To succeed in the exporting of industrial products, a strong technological support is needed, since competition in the international market is based not only on prices but on quality and innovative designs.

In many cases, export industry requires local technological support since it has been difficult to obtain foreign licensing for production of exportable goods.

Summarizing, trade and tariff policies in developing countries have often failed to stimulate interest in the improvement of industrial technology.

Fiscal Policy.

In a market economy, the tax system has an important influence on investment decisions and on the capacity of enterprises to obtain capital. Therefore, it strongly influences the demand for technology.

Taking into account that the social benefit of the generation and adaptation of technology surpasses the private benefit, tax incentives for such a type of investments is justified. The main barrier to grant such incentives has been the difficulty to control the misuse of incentives.

Procurement Policy.

Governments are important customers of many industrial products and could use their buying power to increase the demand for technology of national industry. For that purpose, special allowances for innovative solutions and technical superiority could be granted, instead of always selecting the lowest bid.

A convenient procurement policy cannot only influence the market, to which technology responds, but also reduce the uncertainty associated with technical innovations.

The principal limitation in utilizing a procurement policy for stimulating development of national technologies is the rigid buying regulations of government agencies. These regulations are mainly aimed to secure the honesty of the buying process, without allowing enough regard to qualitative considerations.

CONCLUSIONS.

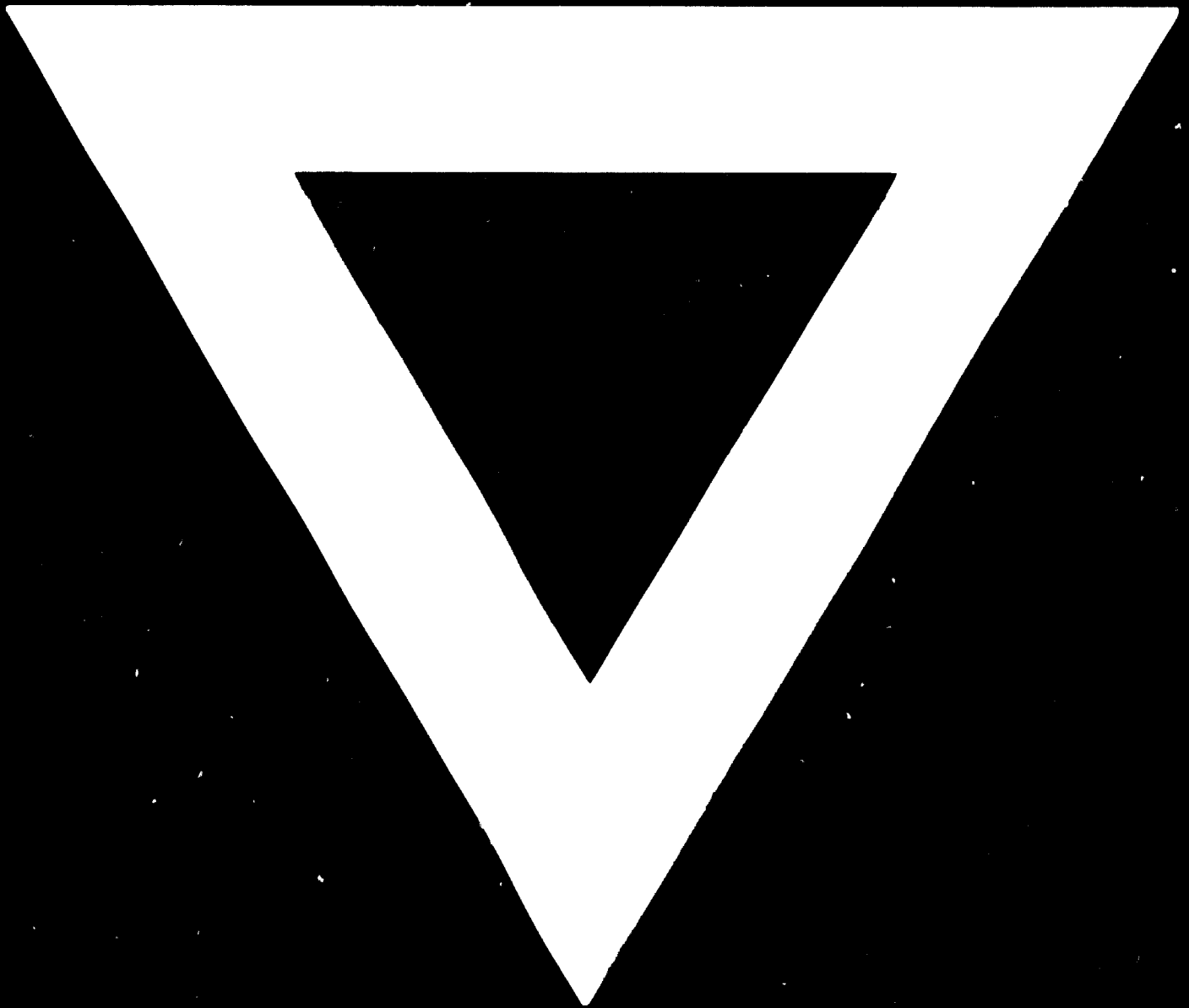
- Spontaneous demand for improvement of technology by enterprises is weak in developing countries.
- The great need for technology of the industrial sector must not be misunderstood as an expression of actual demand.
- Foreign technologies are normally more appealing to industry than locally developed ones.
- The best opportunities for the incorporation of technologies occur through the "pull approach" i.e. starting from the needs of the enterprise and selection of the less costly and fastest solution to the identified technical requirement. Therefore the transfer of existing technologies is the most frequent solution.
- An IRSI interested in selling technology needs a strong capacity in market analysis, project evaluation and industrial management.
- For the improvement of the relationship between IRSI and industry, a substantial part of its financing should come from payment of services.
- The industrial firms are more willing to undertake innovation projects when the required services are supplied as a coordinated "package".

- IRSI's contribution to industry can be increased and improved through the use of intermediate institutions in order to reach a broader spectrum of customers.
- Technology Development Corporations based on the "push approach" are more useful in relatively well developed technical environments.
- Direct government support to innovation projects is justified because their social benefits are larger than the private ones.

When decisions involving economic policies are taken, an evaluation of their impact on the demand for technology by the industrial sector should be made.



C-106



80.02.21