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REPORT OF THE HIGH-LEVEL REVIEW GROUP* ON THE PRINCIPAL ISSUES POSED IN THE JOINT UNDP/UNIDO EVALUATION STAFF REPORT ON INDUSTRIAL RESEARCH AND SERVICE INSTITUTES

Including supplemental remarks
prepared by several participants therein

assembled by
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Report of the High-Level Review Group of the principal issues posed by UNDP/UNIDO IRSI Evaluation Study

INTRODUCTION

1. At the invitation of the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO), a high-level and representative group was invited to convene at Vienna on March 26-30 to discuss and analyze major issues concerning industrial research and service institutes in developing countries. These issues have been identified as a result of the joint UNDP/UNIDO Evaluation Study and included (1) the relative cost/effectiveness of IRSIs versus other alternatives, (2) making more effective use of existing IRSIs, and (3) their potential. To facilitate the discussions, the group was provided with the evaluation report (Id. 79-910) in advance of the meeting for their perusal. The Group greatly appreciated the scope, significance and value of the in-depth study, but refrained from assessing specific findings or endorsing specific recommendations as this was beyond its terms of reference. The deliberations concerning the issues presented and subsequent recommendations are based primarily on the individual and collective expertise and experience of the respective members but included consideration of the results of the evaluation study.

2. By way of an introduction to the meeting, senior representatives of UNDP and UNIDO gave some background information on the reasons why the group has been convened. The two organizations thought that additional outside guidance and advice was needed in order that the results of the evaluation study could find the widest possible application to help developing countries, particularly those in the earlier stages of industrialization, in building up their indigenous technological capabilities.* The issues are regarded as so fundamental and pervasive, that further discussion, validation and/or review was considered essential. The following is a summary of the concensus reached by the participants.

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* Refer to Chapter VII, paragraphs 359-367, of the UNDP/UNIDO evaluation report for fuller discussion of purpose of the review and principal issues.

ISSUE I: "Is an IRSI, involving a significant R + D component, a reasonable option for developing countries which have not reached a more advanced stage of industrialization?"

3. To establish an IRSI is a major step in the evolution of a developing country. A number of prerequisites or conditions has to be met or created prior to the successful establishment of an IRSI. Prerequisites include: Government policies, programmes, development goals and priorities and the necessary environment and institutional infrastructure, such as science and technology departments of universities, multi-functional service institutes, productivity centres, consultancy groups, technological information systems, etc. Where such infrastructure does not yet exist, the country may better start with uni-functional service institutions to offer industrial information, standardization, metrology, quality control, testing and analysis, and other basic services. Therefore, it is clear that a definite stand on the question of setting up an IRSI is closely related to the level of development, including the scientific and industrial technology and infrastructure, that exists within the country.

4. An IRSI, as defined in the evaluation report, may or may not be the model suitable for every country. The institution must be dovetailed into the national goals and priorities and will vary both in structure, purpose, and type of activities it will undertake. The principal requirement is that every country, at an early stage of development, should resolve to take adequate measures within its means to create and make the most effective use of its indigenous scientific and technological capabilities, trained technical manpower and its natural resources. A country should have a clear-cut development policy indicating its goals, objectives and priorities and also defining the technological tasks to achieve those ends. At this point, an assessment should be made regarding the facilities that already exist for undertaking such technological tasks. These should be put to effective use and may be complemented and supplemented by additional facilities as and when required. It is only then one should consider setting up more complicated and sophisticated institutions like IRSIs.

5. On the other hand, IRSIs may be an important element in a country's industrial development, especially in the more industrially advanced countries, but they must be built around the existing critical

service institutions. As soon as it is determined that single or multi-functional service institutions are operating effectively, the creation or strengthening of IRSIs with a research and development component should be considered.

6. In the earlier stages of industrialization, a single-function institution can be adequate to provide basic services to small and medium sized industries or to participate in technical studies with respect to national objectives such as bett r use of the natural resources in exploitation as well as in processing to serve local needs or to contribute to the trade balance of the country. However, as soon as it appears that those types of options are not sufficient to deal with the evolving questions and problems, establishment of one or more multi-functional IRSIs must be taken into consideration. The scientific and technological infrastructure should be designed in such a way that it fits into the stage of development of the country concerned. There must be a climate of confidence, appreciation and motivation of the clientel that is relevant in playing a role for sponsoring and making use of the activities of the IRSI concerned.

7. For the success of industrial research and development organizations, an environment which encourages and permits innovation is called for. Management must be flexible, venture-oriented and autonomous. Necessary conditions should be created for this purpose. Developing indigenous competence, training technical manpower, creating necessary infrastructure with the required expertise and experience, is a continuous and time-consuming process. Therefore, it should be started as early as possible to meet the growing needs and the demands of the industry, and even to keep ahead of the industry.

8. From the foregoing, it is clear that each country must study and decide for itself on the successive steps to be taken for the type of institution to be set up, its organizational structure, and the activities required to develop and improve its competence and to serve its clientel best. In such an exercise, governments should take advantage of past experiences and the help of UN system and other development agencies.

9. When it is clear that IRSIs are relevant choices in a particular country, the question arises what should be the reasonable expectations by governmental and industrial sponsors. The suggested expectations are the following:

(a) to develop the necessary indigenous competence, i.e., human resources, to collect information, to assess, analyze and provide alternatives for decision-making bodies;

(b) to adopt and improve upon the existing or imported technologies, to generate technologies relevant to the needs of the industry - small, medium and large-scale sectors, and provide problem-solving capability, industrial information, consultation and extension services.

Experience shows that IRSIs have not often succeeded in fulfilling all these expectations. It is, therefore, suggested that IRSIs only accept responsibility for those activities which are in consonance with their competence and the priority needs of the clientel including those functions not already dealt with by other organizations or institutions.

ISSUE II: What can Governments and industries do to make more effective use of existing IRSIs?

10. Recognizing that in certain countries IRSIs will have to operate in the absence of clear-cut policies, programmes, or specific demands placed on them either by the government, industry, or other clientele, the onus of responsibility will be with the institute to develop a common industry research culture to make itself effective. The institute should seek every avenue possible to involve the clientele, for example, through industry participation in an advisory committee, to gain its confidence, and to make use of its clientele in advisory, executive, and other committees.

11. Another question considered is whether an IRSI in a developing country should serve government or industry only, or both sectors together. Any nationally funded institute is set up to serve the nation and ought to serve government as well as industry.

12. The primary objective of an IRSI is to develop indigenous competence and necessary qualified manpower for it. An appraisal of an IRSI's effectiveness must be judged primarily by the increased competence it has provided. Therefore training of manpower both in the country and outside and the exchange of personnel and experts will become a necessity. In this process one should consider ways and means to improve the existing performance.

13. To supplement and complement the local competence within the country, assistance from other regional or international organizations are also options for governments to provide the needed contribution in serving the national technological goals. For useful national, regional, and international linkages and cooperation, the prerequisites will usually be to:

(a) identify the technological tasks and sub-tasks;

(b) identify the talents and facilities that are needed and available;

(c) identify areas that will be of mutual benefit and interest to the participants;

(d) determine clearly at the outset the sharing of the benefits that will accrue because of joint collaborative programmes and projects.

Such linkages would also help in achieving results quickly at less cost and attacking problems with a multi-disciplinary, multi-organizational, multi-national team effort.

14. In building effective linkages, organizations like WAITRO and other regional and international bodies may be fruitfully utilized. Other avenues for such cases are twinning and cooperative arrangements, and networking of institutions, viz. between the developing and developing, and developing and developed countries.

ISSUE III: Is there a potential and priority role and/or function IRSIs can or should be performing?

15. An IRSI has the potential for technology assessment, transfer, adaptation, and utilization and for opportunity or prefeasibility studies, problem-solving and extension services and industrial information service systems. However, each IRSI must set for itself certain priorities for building its own competence as it would be difficult to achieve a desired degree of competence in all these areas at the same time. In the actual practice the IRSI should attempt to participate actively and assist appropriate institutions that have the principal responsibility for techno-economic feasibility studies and technology transfer.

ISSUE IV: What kind of dissemination should be given to the staff report and what follow-up actions taken?

16. Dissemination and follow-up actions have particular importance to the joint UNDP/UNIDO evaluation of IRSIs. The requirements for industrial services including research and development differ from country to country but these functions play an essential role in the industrial-

ization process of developed and developing countries alike. Human and financial resources available to carry out the difficult and sometimes risky tasks of industrial research and development are limited. If past and future investments in institution building are to achieve their purpose, the experiences, prerequisites, forecasting and goal setting which have been among the subjects evaluated in the study and reviewed herein should be better understood by the governments, service institutions and industries affected.

17. Therefore, it is recommended that the Governments and the UN system give priority consideration to the following:

(a) to disseminate UNDP/UNIDO evaluation staff report, including an annex of this review group report, to interested governments, development agencies, IRSIs and other relevant groups.

(b) to develop a set of programme and project guidelines from the evaluation results and make them available to interested developing countries. In addition, the UNDP/UNIDO evaluation report, together with supplementary documents, should be distilled and summarized to inform a broad audience including the Group of 77, the UNCSTD secretariat, and other interested parties.

(c) Governments are encouraged to also make use of these documents and others already available that are related to IRSI problems and conduct seminars and workshops to consider the implication of the evaluation conclusions for the individual countries' situation.

(d) This evaluation study represents an innovative step in programme and project management. UNDP and UNIDO are urged to extract the methodology employed in the study to evaluate individual IRSIs. Such a document should be widely circulated to the IRSIs to help them in the task of self-evaluation. This may also be included as a part of project design in setting up new IRSIs. Steps should also be taken to determine, over time, the impact of the evaluation exercise, including its follow-up activities, on industrial research and service institutes in developing countries.

(e) Networks of IRSIs and other relevant institutions can serve a useful purpose in indigenous capacity building if the problem-focus, self-interest of participating institutions, and terms of cooperation are sharply defined and clearly specified. Emphasis should be placed on linkages between developing country institutions addressing problems of multi-country concern for which common action is practical.

(f) At the request of Governments, UNDP/UNIDO should develop methodologies for technology forecasting, assessment and self-evaluation and this be used in the design of technical co-operation projects with IRSIs. Also upon the request of governments the UNDP/UNIDO should develop and conduct management courses for IRSI staff in order to enhance their industrial skills and technology competence.

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28-30 March 1979, Vienna

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COMMENTS ON THE REVIEW OF PRINCIPAL ISSUES POSED BY THE UNDP/UNIDO IRSI EVALUATION STUDY

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The literature[1/2/3/] associated with the recent UNDP/UNIDO evaluation of Industrial Research and Service Institutes (IRSI) points out the infrastructural requirements, planning and clarity of objectives essential to the establishment of a productive IRSI or to the useful expansion of an existing IRSI. This guidance t governments, UNDP and UNIDO may not have the desired impact however because, in my opinion, these documents do not adequately explore the role of research in the industrialization process. This difficult and controversial question is seen by some, myself included, as central to questions about IRSI performance, past and future.

The preamble of the evaluation report[2/] touches on the issue when it states —— "It is important to note that the historical industrial development of the industrialized countries did not require the presence of IRSIs." The report goes on to note that the concept of concentrated and oriented R+D evolved out of the war efforts of the 1940s. Not mentioned is the fact that the direct contribution to industrial activity by independent or government research institutes in industrialized countries is marginal. Research which contributes directly to new or improved industrial products and processes is largely carried out by groups specifically responsible to industry either as part of a company or through an association of industries. Results from government-sponsored research and independent research performed by institutes, universities, industry and others find their way into the industrial stream largely through the efforts of enterprising firms and/or individuals seeking to capitalize on the available knowledge through design, development and application which respond to market pressures.

1/ Institutional Infrastructure for Industrial Development, Laurence L. Barber, UNIDO/ICIS.36, 26 July 1977.

2/ Joint UNDP/UNIDO Evaluation of Industrial Research and Service Institutes, 2d. 79-910.

3/ Report of the High-Level Review Group on the Principal Issues Posed by UNDP/UNIDO IRSI Evaluation Study.

This is an oversimplified description of a complex process but perhaps it aids appreciation that:

- o The majority of industries worldwide do not engage in research (as it is commonly defined).
- o Research conducted by institutions separate from industry rarely has direct benefit to industry.
- o The need for development and marketing is greater than the need for innovation (research).
- o The more common and productive mode for industrial technological advance utilizes the knowledge and skills of persons directly engaged in industry.

The evaluation definition and focus was on the institute — "which has a major research and development component." Thus it should come as no surprise that in many developing country IRSIs have little or no participation in any aspect of the industrialization process. There are exceptions as always but by and large IRSI is a misnomer; RSI would be more descriptive.

Such institutes survive and, in some instances, prosper in the industrialized countries because those governments support relatively extensive R+D. There is recognition that an acceptable fraction of the knowledge generated by research will ultimately have industrial application. This fractional transfer is aided by the relative mobility of technical persons between industry and institutions and by industrial efforts to utilize external knowledge, factors which are not often present in developing countries.

The need to facilitate industrial innovation in developing countries is great as is the need to develop indigenous capacity in the many aspects of the industrialization process including research. If one accepts the notions that industry is not prone to engage in or support research and that in developing countries the diffusion of technical knowledge to industry is too expensive of time and resources, then what are appropriate roles for an IRSI and how can desired change be accomplished? The report of the review group [3], in particular paragraphs 10, 11, 12 and 15, does not adequately address these questions, in my view.

The question of paragraph 11 (whether an IRSI should serve government, industry or both) is less germane than the question of who should be

responsible for setting the goals, selecting the technical areas and tasks, and evaluating the performance of IRSIs. In order to stimulate market pressure for IRSI services and increase the relevance of those services the preferred approach is to make industry responsible and accountable for the IRSI even if funding is provided totally or in great measure by the government. The U.S. government has, in several instances, contracted with industry and universities to manage and operate major R+D facilities.

Governments may not be willing to delegate responsibility for an IRSI or industry may not have the capacity to discharge the responsibility in which case the government must be accountable for the IRSI. If the government does not take an active role in helping to set priorities, facilitating interaction with industry (including industrial training for IRSI staff), and continually evaluating performance, the IRSI is likely to remain isolated and marginally productive.

The report of the Review Group suggests that IRSIs particpate in the assessment, prefeasibility study, transfer and adaptation of technology. These functions are needed in the developing countries but cannot be performed successfully without an appreciation of national priorities and industrial constraints. IRSIs are often too isolated from the realities of politics, finance, production and markets to achieve the necessary understanding.

In summary, research is not perceived as an urgently needed service by developing country industries, with some justification I might add. An institute with a significant research component is likely to employ persons whose outlook, skills and approach to problems differs from that of the industrialist and the politician. In cultures with a strong technological base, redundant information channels between societal sectors and market pressures for technical change, these characteristics of an IRSI do not greatly reduce its utility. Otherwise, strong extenal guidance and management are needed if an IRSI is to contribute to industrialization in the short term.

Supplemental Comments
by
Dr. Johan C. Gerritsen
Secretary General
WAITRO

I. The UNDP/UNIDO study, with one exception only (KIST), concerned the analyses of the co-operative efforts in institution building on the basis of multilateral support.
For the time being I do not know whether the outcome of international co-operation and twinning within a bilateral framework will be approximately the same as such of the United Nations or comparable international organizations.
Bilateral aid programmes may have certain advantages in their administrative and managerial handling. Bureaucratic systems are more simple ar more stabilized. If less people are required in decision making and in the execution of a project, more individual and less collective feelings or responsibility and involvement are beneficial assets in making an IRSI successful.
Especially building up personal relationships between civil servants of the donor and recipient countries, research directors, project leaders and team members are valuable conditions to improve common operations.
To avoid any misunderstanding I want to state that international agencies cannot be blamed for their work, because those systems have certain constraints in flexibility, freedom of action due to their responsibilities to member countries and/or other sources of funding, that less structured or constrainted agencies do not feel so intensively, or do not face at all.

If this is true, prospects of IRSI's in developing countries may diverge according to the characteristics of donor agencies and the IRSI's, chosen as subcontractors.

II. It is common practice that R+D activities of a research centre are evaluated through its contributions to public and private industries.
But it is also quite usual that trials to measure practical results of R+D are very disappointing.
Only in cases that technological bmeakthroughs are realized, e.g. in the field of plastics, spectacular R+D results became obvious.

But examples of that type are exceptional. To my opinion there are several reasons why IRSIs in the context of "indigenous technological research potential" ought to be seen and evaluated on a somewhat broader basis.

a Normally the outcome of industrial R+D is oral and written guidance to improve processing and products in the manufacturing industry. Control and improvement of quality, reduction of costs, i.a. through introduction of optional materials and techniques are important contributions by IRSIs. The main significance of IRSIs is to help single firms in their struggle to stay in the markets, to keep up with their competitors. This is top priority. Next comes the desire to become stronger and bigger.

It is the fate of most IRSIs, both in developing and in industrialized countries that the R+D output is difficult to trace. To measure the output in terms of GNP is mostly neither possible nor applicable.

Maybe it is more realistic to evaluate R+D output along another way. What will happen to an industrial firm or industry sector, if normal research facilities are not available?

I am afraid that the answerwill be: a gradual fall of these firms and, in the long run even a total collapse.

Look to the national/nationalized industries in developing countries with poor or no means for technological support. Look to their prospects in comparison with those of foreign based firms that can rely on hired research facilities and those of their own in their home country ! Huge countries like Brazil and Indonesia suffered a lot in this respect.

b In many industries it will not be sufficient that there are only research facilities at hand in their <u>specific</u> fields of interest. Frequently processing techniques and product designs have become so complicated that adequate technological support must be obtained from a variety of specialized research centres.

A simple furniture factory needs R+D assistance concerning a series of materials (wood, steel, plastics, glass,glues) and subsequent techniques.

So it may happen that even a prominent IRSI, specialized in one or two areas, will be of unsatisfactory value if complementary research facilities are lacking.

Diversity of R+D facilities is an important factor for the usefulness and effectiveness of research. This raises a question concerning the "critical mass" of R+D potential so as to get the optimum benefit of each single IRSI.

c In countries at such a stage of economic and industrial development, where R+D in its technical sense seems to be feasible for the introduction of new techniques or new products, special condideration must be given to the financial consequences.

From statistical analyses that I once made with help of data collected by the U.S. National Science Foundation, it revealed that implementation of the basic plus applied research into development needed already twice as much investment. After the stage of development, total effort needed for gross investment in industry was <u>fourteen</u> times the expenditure in R+D and <u>seventy</u> times the expenditure in applied research only.

This may illustrate the sacrifices and heavy risks, that a developing country will fail if it becomes ambitious.

d Finally, with respect to the distinction made in our considerations between an IRSI and a service institute, it seems to me that a service institute can only be qualified as competent and reliable, it if has a built-in research component to sustain its routine business. This refers especially to good performance of trouble shooting.

COMMENTS ON THE QUESTIONS CONTAINED IN THE UNDP/UNIDO DOCUMENT
"EVALUATION STUDY ON INDUSTRIAL RESEARCH AND SERVICE INSTITUTES"

1. An IRSI may serve as an additional instrument designed to contribute to a country's national efforts to promote its industrial and technological development.

From the very outset, the decision to establish an IRSI must be taken in the context of the country's industrial development policies, or, in the absence of such policies, the creation of such an institute may be intended to consolidate a more or less advanced industrial development process. In any case, the IRSI must be conceived as an institution furnishing industry with basic services, without any involvement in the transfer of technology area, and dedicated to the following tasks: the analysis of raw materials and industrial products and by-products, quality control investigations, technical and economic prefeasibility and investment opportunity studies, technical standards services, etc. The IRSI must operate on behalf of both the public and private sector and be capable of advising the Government on matters relating to import taxes on raw materials and semi-finished and finished products.

If a manpower training function is included among the IRSI's responsibilities, this function must be consistent with the country's over-all policy in this area, or, if no such policy exists, any training programmes contemplated must be co-ordinated with the existing educational institutions.

The solution of calling on existing educational institutions to provide industry with basic services as an alternative to the establishment of an IRSI for this purpose should, I think, be rejected in view of the suspicion which the industrial sector is known to entertain towards the universities

and academic centres when matters of such great sensitivity and impact on the marketing and sales of industrial products as quality control, the study and establishment of technical standards, etc., are at issue. Experience has shown that not much can be accomplished by involving the university community in tasks of this kind because, generally speaking, these institutions are constantly confronted with political and social problems typical of developing countries which are incompatible with the thinking and activities of those responsible for the financing and management of industrial development.

As I see it, developing countries need to develop their own pool of highly trained officials specializing in the selection of technology and the negotiation of its transfer under a regulatory system consisting of legal procedures governing the purchase of patents, equipment and processes. Moreover, it seems to me that it would be more economical, efficient and responsive to development needs if the adaptation of transferred technologies and technological innovation (where necessary) were to be a function of the industrial sector rather than undertaken through parallel work at the IRSIs.

I have the impression that, for countries at the first stages of their development efforts, the theme of "appropriate technology" has been conceived within an ill-defined political context and that the popularization of this theme has awakened false expectations. The existing IRSIs were originally given responsibilities in this field and later they were accused of failing to discharge them, a failure which, in the eyes of the public, has been grounds for questioning their effectiveness.

The fact is that, while the term "appropriate technology" may be attractive, in reality this is a costly and difficult goal to achieve for countries poor in financial and human resources, and even at best the time required to attain it will be difficult to justify in the face of society's need for more rapid industrial development.

The functions proposed for the IRSI - basic services for industry - would be consistent with the objectives pursued in the financing of industrial development: increased levels of production, national consumption and export activity, and greater employment opportunities for those qualified. Industrial development is one component of the general development concept, which also includes public health, education, morality, culture, social and political institutions, and other factors. As a consequence, the IRSI, which is created and operates to support industrial development, should not be envisaged as an institution affecting every aspect of this process, but as designed to contribute to one of its components.

If while functioning within this conceptual framework the IRSI demonstrates its effectiveness, and if society as a whole succeeds in moving forward to higher levels of development bringing with them the need for the introduction of technological research, the Institute must respond to this requirement in a realistic manner through the mounting of practical research projects.

2. In the absence of national policies in the area of science and technology and/or of industrial development planning, an IRSI may operate under objective guidelines geared to meet local conditions. It seems to me that there are a number of factors that will determine whether these guidelines truly reflect national requirements and will accordingly gain public support, or whether they are unrealistic in substance and scope and will thus be rejected. Among these factors, I should like to mention the following:

(i) <u>The Institute's place in the hierarchy</u>

Some IRSIs are hierarchically subordinate to central banks, others to the Ministry of Industry and Commerce, the Ministry of Finance, the Ministry of Planning, etc., and still others to several ministries simultaneously. Certain of these hierarchical arrangements give rise to

operational confusion, with functional overlapping, duplication and rivalry at the ministerial level, resulting in the paralysis of the Institute's executive organs; in other cases, it becomes isolated, adversely affecting the definition of operational strategies.

Experience would seem to indicate that the best place for an IRSI in the organizational hierarchy is within the Ministry of Industry and Commerce.

(ii) The composition of the Institute's Committee or Governing Board

Depending on its organizational situation, the Institute's Committee or Governing Board may or may not be sufficiently representative to formulate programmes of action responsive to the real needs of the sector. Generally, the membership of these bodies represents the financial and administrative sectors of government and industry, but includes no spokesmen of the scientific and technological community either of the Institute itself or of the country, to the point even that the directors of the Institute themselves may be given a voice but not a vote in the deliberations.

(iii) Co-ordination with other national institutions whose work also has a direct or indirect effect on industrial development is important in order to ensure that the programmes approved complement rather than duplicate the national effort in the areas of interest.

For the purpose of making possible the co-ordination of planning at the regional and international levels, I should like to propose the following:

(i) The formulation of pilot integration programmes by regional areas - for example, the Caribbean and Central America - aimed, among other things, at:

1. An exchange of administrative and technical experience;
2. The formulation of training programmes for technical and administrative personnel;
3. The organization of library catalogues and data banks to permit the establishment of a horizontal information-exchange system to supplement the holdings of each participating institution;
4. The development of standard machinery for the evaluation of institutional efficiency and an exchange of experience on the basis of actual results;
5. The formulation and implementation of such joint projects between two or more countries of the region as may be declared to be of priority importance by their Governments.

A pilot programme of this kind might be designed to operate for five years and would be one way of rationalizing the contribution of the international financial agencies. The creation of various pilot programmes in the regions where the countries at a low or medium level of relative development are located might lead to a review of the current world-wide pattern of highly bureaucratized and ineffective specialized organizations. I also feel that a kind of interregional council should be set up with the participation of regionally appointed delegates to maintain permanent umbrella consultations; the number of delegates should be small, to allow expeditious action on the basis of clear-cut responsibilities.

I do not think it useful for the international organizations to spend money on the organization of purely social get-togethers between institute directors; instead, the technical basis of these institutes should be consolidated through additional training fellowships, technical meetings, access to bibliographical materials, etc.

Armando José Nunis
Rio de Janeiro, 27 April 1979
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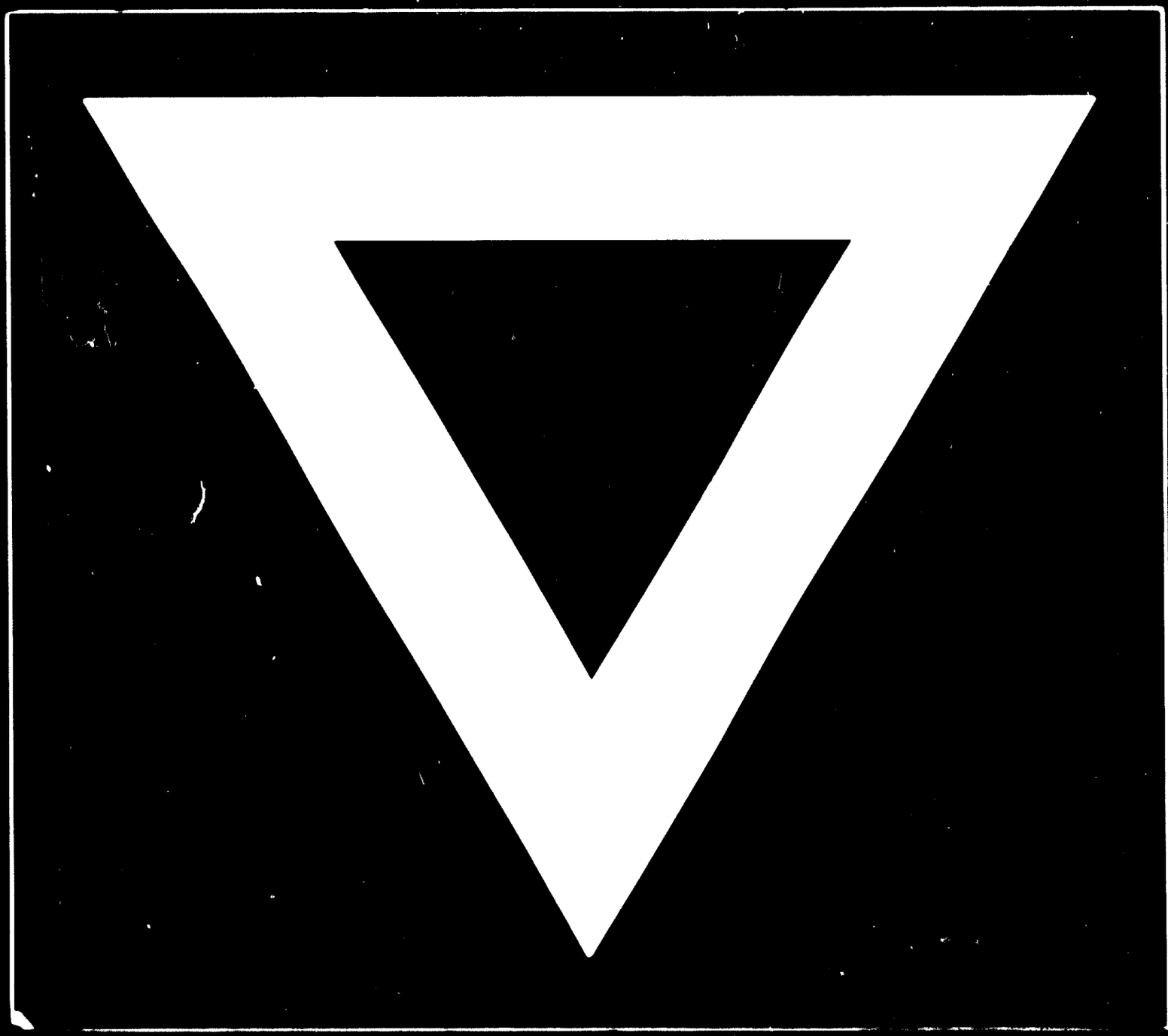

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