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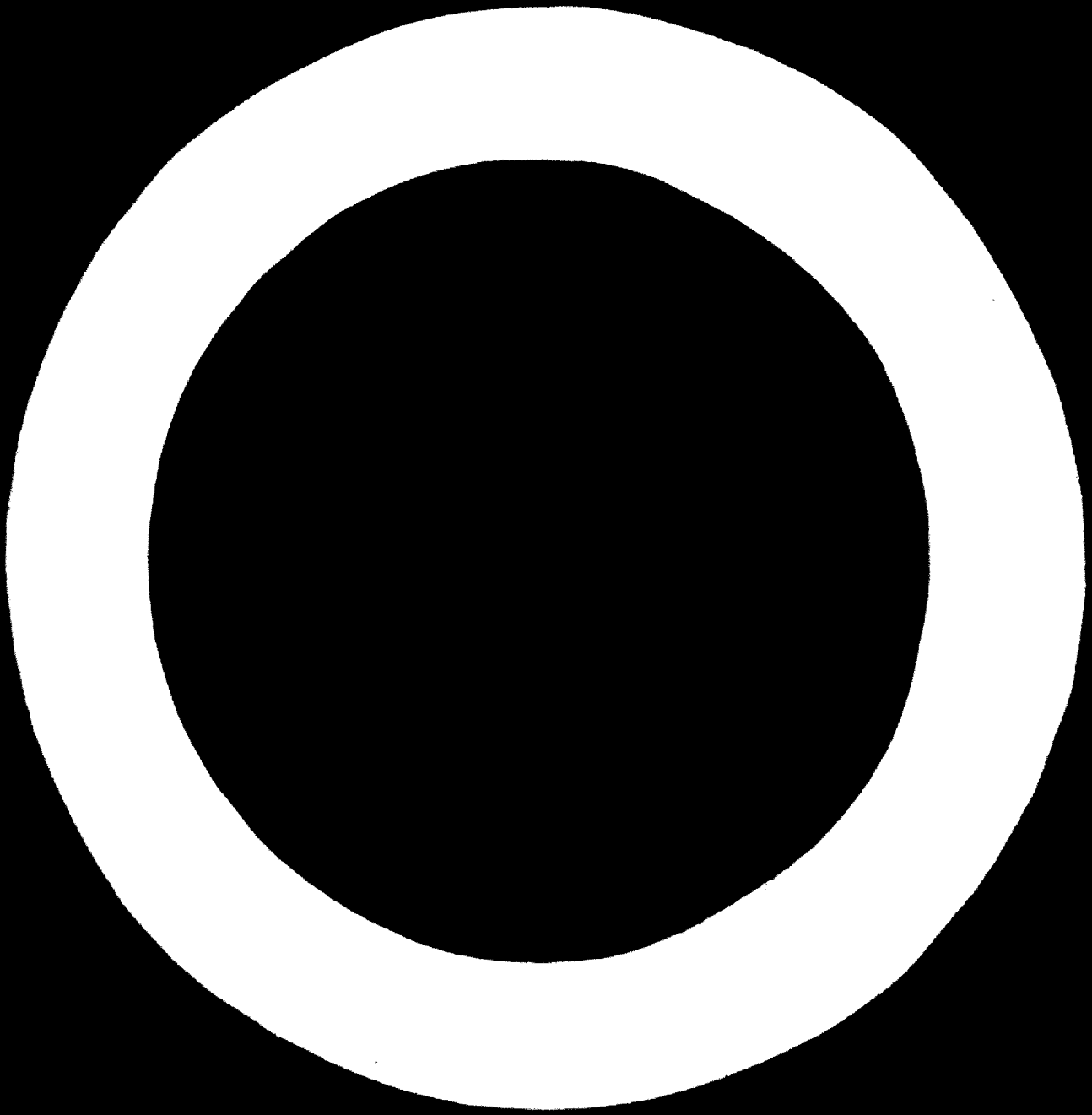
APPRAISAL OF THE PERFORMANCE
OF INDUSTRIAL SERVICES BY TECHNOLOGICAL
INSTITUTES IN DEVELOPING COUNTRIES ^{1/}

by

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I. THE MANAGERIAL IMPORTANCE OF ORGANIZATIONAL EVALUATIONS

Appraisal as an Essential Managerial Function

Authorities on management usually list five functions as necessities for effective administration: planning, organizing, staffing, supervising, and controlling. These activities are generally oriented toward current tasks and are therefore addressed to the present and short range future.

To ensure longer range success a sixth function must be added, namely, appraising. Unless managers review in depth the results of their procedures and programs, they fall into a pattern of stereotyped practices. These appear to have been adequate in the past but may well fail to provide the basis for an optimum future. Only by careful study of what might be achieved by other strategies and tactics can they keep their managerial postures aggressive through the selection of alternate courses of action. At the same time they will create a sturdy sense of purpose in their organizations.

The most positive techniques for measuring the quality of management in an industrial enterprise are of course quantitative. These are necessarily based on past history in that they refer to previous results of current policies, but it is common practice to use them to project trend lines. Examples of quantitative measures are such data as production cost, sales in the market place, and the margin between expense and income. Additional numerical aspects of operations are found in capital resources, physical volume of production, size of inventories, turnover in personnel, and the like.

There are still other attributes of management having great bearing on potential strength for the future which we are not able to qualify. Their appraisal is necessarily a subjective judgment, but means can be found to reduce the element of bias in individual opinions by using an appraisal team. In particular, information to permit comparison with

the performance of other typical organizations is valuable. Some topics in this category are the nature of administrative policies and procedures, the character of planning activities, the efforts to develop personnel resources, the quality of public relations activities, etc.

Procedures for evaluating technical programs are urgently needed. They are vital factors in determining the future of the organizations that they serve, and they are becoming increasingly expensive. Much study is being given to the question in research departments in highly developed countries. It is true that yardsticks are available for assessing the value of projects that have already been completed and implemented, and also for making estimates of the probable benefits of investigations currently in progress. But the evaluation of a complex mixture of technical activities still remains a matter of personal opinion.

There are two basic reasons why such appraisals are so difficult. First, the research department of an enterprise is responsible only for the technical services that lead to the development of new information, and it cannot be held accountable for its use or lack of use in operations, which depend on decisions outside its control; even though the program appears to be sound, it will not have a proportionate impact unless the management takes steps to apply the results. Secondly, the proposed measures of research productivity can embrace in a meaningful way only work that has been done in the past. The future is uncertain because of rapidly changing technology in world competition and the variations in economic climate, and because of inability to foresee the use that will eventually be made of new technological developments by the rest of the organization. Any attempt to appraise the composite program must therefore rest on judgment that takes these factors into consideration.

Technological institutions, however, offer an unusual opportunity for factual appraisal. Their purpose is to provide technical services to industry. How well they are accomplishing this mission can be determined by analysis of their activities in terms of the satisfaction they are giving to their clients, which is reflected by the volume of requests they receive for services requiring payments of fees by clients.

This information provides a factual basis for examining their organizations and operating principles to reach conclusions as to how they can increase their strengths and reduce their weaknesses. This same scheme could be adapted to the evaluation of an internal technical department in an individual enterprise, but this is not being done because the incentive is not so imperative as it is in the case of an independent technical institution.

Technological Needs of Developing Countries

Before we can proceed logically to the appraisal of technical institutions in developing countries we should first consider the industrial environment in which they operate.

The great majority of enterprises in developing nations are of small or medium size. Their owners or managers are faced with a wide variety of commercial problems which take precedence because they are vital to economic survival. Most of these decision makers have little if any technical background and are even unaware that they need, can obtain, and can apply technological assistance. What they require is practical help on practical problems and they have no interest in the theoretical background of the technology. By contrast, the large plants have usually been installed largely on the basis of foreign know-how and there are channels already available to them for obtaining technical advice on a continuing arrangement. This situation is not confined to developing countries, but exists in all nations; large enterprises have internal technical competence, but the problem of providing effective help to small firms continues to be a major concern.

The sequence of demands for technical services of different types follows a characteristic pattern. First there is need for immediate and direct assistance on improving quality of products or starting materials and this is provided by analysis and testing activities. This type of service is closely followed by a demand for advice to overcome urgent production difficulties, which is obtainable through the know-how of technological experts. Then there arise requests for more complicated improvements in product or process and in some instances for the development of simpler forms of new products, the handling of both of which normally depends on the adaptation of available technology to the particular problems. Only when the enterprises become more

sophisticated and venturesome is there a request for radically new technology, but this too is in nearly all cases derived from information already described or applied elsewhere. The same pattern of progressive movement in the level of technological requirements occurred also over many decades in highly industrialized countries and even today adaptation is the rule; only in industries with rapidly changing scientific background is there a need for basic research to seek entirely new knowledge.

In developing countries, therefore, the emphasis should be necessarily on adaptation of technological information from all possible sources. In many cases the course of modification to suit local requirements is quite direct. In other instances the adaptive process may require great ingenuity and imagination, as in the recovery of economic values from a unique raw material, but even here the basic knowledge that is essential will in the vast majority of cases be found in the technical literature.

The availability of this tremendous pool of knowledge is a fortunate circumstance for developing countries. Instead of having to develop the information afresh, as the industrialized countries have done over many decades, the need is to choose wisely from this technical reservoir and to reshape it in a form needed for specific problems. This situation permits more effective allocation of the limited resources of specialized manpower. The fact that the information has often been reduced to practice in other countries affords experience which reduces the risks in new ventures and thus conserves investment capital.

Advantages of Technological Institutions

Most authorities on economic development subscribe to the view that independent industrial research institutes are one of the most effective agencies for stimulating improvement in the national technological posture. The following quotation from the United Nations "Manual on the Management of Industrial Research Institutes in Developing Countries", New York 1966, expresses this conclusion in strong terms:

"The accepted instrument for successful industrialization today is generally called an industrial research institute, although its work is by no means limited to research. As defined for the discussions which

follow, an industrial research institute is an organization for rendering locally various technical services and for carrying out scientific, engineering, economic, or socio-economic investigations on industrial projects believed to have ultimate practical significance, whether such projects are initiated by the organization itself or proposed by individual establishments, investors, industry associations or government agencies. The clients, including government agencies, asking these services of such an institute, may pay part or all of the cost".

The advantages of a technological institution rest on the following features. Their staffs consist of a diversity of specialists with different backgrounds of expertise. Their managements have acquired skill in diagnosing technical problems and in allocating professional personnel to individual projects in accordance with needs. These institutes provide a diversity of competence for providing a wide spectrum of technical services; the most successful offer also expertise for carrying out techno-economic evaluations. They enjoy the advantage of convenient location for direct communication with representatives of industry. They are familiar with the local industrial environment. They provide a focus for the use of know-how from abroad, not only through their library collections, but also through their contacts with foreign organizations.

The merits of industrial research institutions are widely recognized in highly industrialized countries as an important resource for assistance to industry. There are several hundred of them in successful operation throughout the world.

Unrealistic Criticism of Technological Institutes

In spite of the contributions they have made to industrial evolution in countries in which they exist, critics continue to make unfavourable comments about their performance. These are often based on unrealistic expectations as to what they can accomplish. In the following paragraphs the major types of complaints are cited and rebutted. These statements are by no means to be interpreted as a blind defense of such organizations, because even the most productive can effect major improvements in management. The rest of this manuscript is devoted to study of areas of weakness and suggestions for more aggressive administrative policies.

It is often said by the uninitiated that these institutes have not had a marked effect on economic development. This type of comment overlooks completely the fact that a technological institute does not by itself introduce technological change, but its influence is felt only to the extent that its services are used and applied by public and private enterprises. The complaint should be turned in a different direction, namely, that the industrial sector does not take proper advantage of this valuable resource which is readily available to them.

They have not expanded rapidly enough, according to other critics. As a practical matter of administration, technical organizations can rarely expand at a rate greater than 15 percent, or at most 25 percent, per year because of the difficulties of recruiting, indoctrinating, and programming the work of new professional staff members with appropriate qualifications. Further, in the case of technological institutes in developing countries, their rate of growth is limited by the extent of use of their services on client problems. Nevertheless, the most successful organizations have expanded at a rate of 15 percent or more during the period of their existence.

The complaint is often heard, particularly in academic circles, that these institutes are not doing research but are confining their activities to the more pedestrian forms of technical service. This is exactly what they should be doing to meet the existing needs. It was pointed out earlier that improved technology in small and medium enterprises is brought about by practical assistance on practical problems, and not by theory. Only as local industry gradually becomes more sophisticated from the technical point of view will there be an increased need for scientific research.

Critics in the educational field frequently point out that in technological institutes the level of advanced training in scientific disciplines is not high among the staff and that there are few members who hold a Ph.D. degree. It follows from the preceding paragraph that the demand from industry for technical services lies chiefly in the realm of know-how and the direct application of expertise based on practical experience. This kind of technological assistance is best supplied by knowledgeable technologists and engineers rather than by scientists with a theoretical background.

Finally, these institutions are often criticized because they have not had marked impact on the improvement of small and medium enterprises. This is a universal problem not confined to developing countries, and even in the most advanced nations its solution has not been found because of the difficulties of reaching the large numbers of smaller firms in a practical way that overcomes their lack of technical receptivity.

In conclusion, technological institutes in many developing countries have become firmly established as a major technical resource for economic development. The growth in numbers, size, and competence is encouraging, but they should receive much more public support from leaders in industrial, financial, and government organizations. Their managerial practices are being improved and UNIDO has played a leading part in stimulating better administrative practices. The opportunities for helpful exchanges of experience on common problems of management are increasing. As more attention is devoted to the systematic evaluation of their policies, programs, and procedures, they will surely find ways of becoming still more active forces for the stimulation of improved technology in the countries which they are serving.

Although these criticisms may not have a sound basis in the case of more successful technological institutes, the comments can not be ignored. Those organizations which are well established should continually re-examine their policies and programs to find improved ways to serve the industrial sector. In particular, their public relations activities should emphasize their positive contributions to economic development in a manner that will impress enterprise managers.

II. METHODOLOGY FOR EVALUATION

This section describes methodology that has been applied practically for appraisal of some industrial research institutes in developing countries. It includes quantitative procedures wherever possible, but the interpretation of the findings for purposes of evaluation still rests on the subjective opinions of those making the study. For the most part, therefore, the conclusions from an appraisal are qualitative; hence the selection of individuals to carry out such an investigation is of prime importance.

The presentation is divided into three parts: (1) evaluation of work performed for clients; (2) appraisal of the in-house program supported by general funds of the institution, (3) assessment of managerial policies and practices, which are basic factors in current performance and are major determinants of future success.

Appraisal of work performed for clients or sponsors can be based on quantitative data on volume of financial support, number of projects or cases completed, number of studies that have borne fruit by industrial application, and even in surveys of the opinions of clients regarding the quality of services received. Conversion of these data into conclusions regarding the performance of the organization, however, rests on individual opinions of the appraisers. They must take into account the number of years the institution has had to establish its position, the scope and size of the organization, and the external environment for industrial development in which it has to operate.

Appraisal of in-house activities, supported by the institute's general funds received from public or private sources to maintain its existence, can in part be on a quantitative basis including number of projects carried out and actual use made of the results by the industrial community. Much of the work, however, will still be nascent in industrial significance because of the time lag between the development of technical information and its direct application by private or public enterprises. The evaluation must therefore hinge on subjective opinions regarding managerial selection and prosecution of projects, and on measures taken to encourage use of the results by industry.

The appraisal of managerial quality is of necessity qualitative because it is concerned with intangibles. Major aspects for evaluation are: general characteristics of the organization; procedures for planning and controlling the program; quality of the technical staff and measures for improving its capabilities; public relations activities particularly with regard to their bearing on the creation of demand for technical services by industry.

Evaluation of Services to Clients

Percentage of Income from Fees. A good index of the effectiveness of a technological institute is provided by the percentage of its

income from all sources represented by fees paid by clients for its services. When the figures are compiled for a series of years, the increase in client patronage shows the rise in esteem in which the organization is held by the industrial community. Also the data permit the projection of estimated future growth rate for these activities.

For meaningful interpretation, however, the data need to be compared with a reasonable expectation. In highly industrialized countries, well managed organizations offering technical services earn not only enough to pay for all operating expenses, including cost or amortization of facilities, but also to provide a surplus for future growth. In developing countries, however, the size, diversity, and technical orientation of the industrial sector will not yet permit such a happy situation. Instead, because these institutions perform a valuable public function by providing assistance in promoting industrial expansion, they must rely on continuing support from their sponsors until the nation reaches a relatively high degree of economic development.

The number of years during which the institution has been operating must also be taken into account, because an extended period is required for it to develop competence and to create the public acceptance of the value of its services which will attract an adequate clientele. Also, limitations of the types of assistance it offers will diminish its opportunities to attract industrial projects.

Unfortunately, there is not a large body of information on which to base a comparative appraisal. Nevertheless, actual experience of some technological institutes permits some general guidelines. In a developing country with a population of 15,000,000 or more, in which diversified manufacturing industries account for roughly a quarter of Gross National Product, a well managed organization after 10 years of operation may earn as much as 50 percent of its operating costs. Such performance would rate as excellent, while 25 percent of earned income would be modest, and less than that would not be encouraging. Even more significant for purposes of evaluation, because it avoids the intangible influence of the national environment, is the annual rate of increase in earned income or in percentage of total income, as a measure of aggressive management and staff competence. An increase over a period

of years averaging 10 percent per annum is excellent, 5 percent satisfactory but a challenge to improvement, while less than 5 percent is mediocre performance.

For situations less favorable to technical services from institutes, available information does not permit such appraisals of percentage of total income provided by fees, and more reliance must be placed on other factors. The rate of growth in fee income, however, still remains as a valid index, and 10 percent per year is excellent, while less than 5 percent is indicative of the need for improving services and promotional efforts.

In setting fees for services to clients the preferred procedure is to adjust direct salary costs for all overhead expense; usually total overheads are allocated on a pro rata basis. When the policy is to charge clients only for direct salaries or only partial overhead, it is a constructive practice to give clients at the time of billing a statement of the true cost of the work done for them; this will prepare them for later adjustments in fee schedules. Such a procedure is part of the educational program to make the industrial community aware of the fact that charges for technical services are legitimate expense items comparable to those incurred for legal, accounting, engineering, and other types of professional assistance.

Good managerial control of an institution calls for a breakdown of fee income into receipts for major categories of services. This will reveal trends in pattern of activities and will make apparent deficiencies in costing procedures. The following classification is suggested for this purpose and it will be used or implied throughout the rest of this manuscript.

Information services are generally provided for simple inquiries without fees, except for out-of-pocket expense for reports and communications; the cost of the work should be kept track of, because it is a valuable public activity and also a good public relations function since it will often lead to requests for other forms of professional assistance. Analysis and testing should be charged to clients at total cost because they would have to pay for similar work performed by other private or public laboratories. Technical advisory

services on minor product or process problems are usually only partially self-supporting, but it is possible to recover some of the cost by charging per diem rates for time spent in visits to client plants. Short-term projects for product and process problems are usually only partially self-supporting, but it is possible to recover some of the cost by charging per diem rates for time spent in visits to client plants. Short-term projects for product and process development should be paid for by clients at regular rates. Longer-range projects may be undertaken on a cost-sharing basis with the client, in order to encourage this type of work, but it is good practice to negotiate an agreement for later recovery of additional funds from the economic returns accruing to the enterprise from commercial use of the results. Techno-economic evaluations are usually charged at regular rates because users of these services are accustomed to this practice through experience with other consultants.

Government agencies should pay fees at customary rates for all technical services which they request of an institute. There is sometimes a belief that projects carried out for public organizations should be gratis, because the general funds for support are directly or indirectly from treasury funds. From the point of view that it is in the public interest to stimulate the growth of such an important national resource, government bodies should set a good example to the private sector by defraying the cost of work carried out in their behalf. Also, if they did not use the services of an institute they would have to assume the greater expense of setting up their own technical organizations and facilities. Although these principles are recognized in most developing countries, there are some exceptions. Where public agencies provide technical services, which may be in competition with a technological institute, they should charge corresponding fees so as not to place those institutions at a disadvantage.

In some countries it is the practice to collect fees for technical services as an addition to the public treasury, instead of allowing them to be paid directly to a technical institute. This policy is not recommended because it reduces the incentive to the organization to expand its work for clients, which is the most direct route for the practical utilisation of technical services.

Appraisal of Work Completed for Clients. It is surprising that many technological institutes fail to make adequate summaries of the amount of services they have rendered to the industrial community in response to direct requests. They often devote considerable effort and expense to the preparation of bibliographies of scientific and technical papers, on the other hand. These may impress the professional community, but in general they make little impact on industrial managers except perhaps in a few larger organizations.

What does help to convince executives in industry that technical services are important to the success of their enterprises is evidence that other managers are making use of this resource. Hence it behooves technological institutions to compile running summaries of their operations for clients and to use them aggressively in promotional activities.

Few institutions have kept account of the number of technical inquiries from industry which they have handled. This is a very important public service, usually performed at no cost, and an institute that has attained good recognition in its community may well show an average of more than 100 questions answered per year per professional staff member. Contrary to the general impression, these inquiries are largely for expert technical opinion on practical operating problems, and only secondarily for citations from the scientific literature, which non-technical managers of small and medium enterprises are unlikely to be able to use effectively. Replies to inquiries of this sort often lead to requests for other types of technical services.

The number of analyses and tests carried out for clients, preferably on a self-supporting basis, are easy to compile on a periodic schedule. In some institutes they reach a total of several thousand per year. Emphasis on this important technical service, however, is often overlooked in preparing accounts of assistance rendered to industry. The same neglect is true with respect to the number of instances of "trouble-shooting" or help on short-term operating difficulties.

Many projects for short-range investigations, longer term development, or techno-economic evaluations are confidential with respect to specific data, but opportunities are often overlooked to summarize them in a way that does not disclose proprietary information. A periodic review of the number and general nature of these activities is the sort of report which stimulates the inclination of other industrial managers to make use of these available services.

Compilation of these kinds of data are of great value in the administration of technological institutes, particularly when they are broken down by types of services, categories of industry, and size of enterprise. They reveal those areas which are showing healthy growth and will require expansion of staff and facilities, as well as being potential sources of increase in earned income. They point out activities which appear to be in little demand and should therefore receive less emphasis in planning unless it is believed that greater promotional effort could revivify them.

Appraisal of Value of Work to Clients. Technological institutes would find, if they carried out the analysis, that an important share of their current sponsored work, often more than one-half, is supported by former clients who were favorably impressed with the results obtained from previous assignments. It is therefore particularly important that institutional directors should try to accumulate evidence on how well they are satisfying the needs of those who request their services. Moreover, this record of practical accomplishment is a potent instrument for attracting a larger clientele.

An important step for analysis of client satisfaction has recently been undertaken by a technological institute in Latin America. Two local management consultants conceived and carried out in its behalf a mail survey by questionnaire of former clients regarding their opinions on the quality of information received, the speed of service, the cost, and the capability of the staff. Other questions asked concerned the way in which the problems were handled by the organization and how the particular enterprise had learned about the services offered by the institute. This survey provided the management with valuable data about the acceptance of its capabilities by industry. In this case the

responses turned out to be very favorable. The results were tabulated according to the size of the enterprise responding; as was to be expected, a much higher proportion of the larger firms were willing to express an opinion.

This project is very commendable and it should be used by other similar institutions as a systematic procedure for obtaining an evaluation of their performance. For this purpose, an anonymous questionnaire would probably bring forth a larger number of responses. Also, a break-down according to industry and type of service would provide a still more effective instrument for managerial consideration.

Even without going so far as a survey on this scale, every technological institute should try to collect quantitative information on the way its services appeal to the industrial community. For less time-consuming and costly activities such as information services, analysis and testing, and trouble-shooting, the trends in number of requests and in new clients provides a good measure of their value. In the case of studies in greater depth, such as product and process improvement or development, many enterprises will be willing to have the institute release statements about the part it has played in bringing about the use of new technology, and this can be done without disclosing confidential details.

Data of these types are invaluable in public relations with the industrial sector. Institute managers should carry out a continuing program to accumulate the information in most impressive form. The figures are, of course, very useful for internal administration because they reveal trends in the types of services, categories of industry, and sizes of enterprise in which growth in demand can be expected.

Evaluation of In-House Programs

Most technological institutes in developing countries are deficient in the objectivity of the analysis of the way they spend their general funds to support internal projects. These are likely to be selected on the basis of their scientific interest to members of the staff rather than on their appeal to industrial managers. Once launched, they are frequently allowed to continue indefinitely without application of criteria to judge their commercial feasibility. They tend to end

up as technical papers or reports and not as contributions to economic development.

The two governing reasons for the support of in-house projects should be to develop new concepts as far as the stage at which they can be judged for entrepreneurial appeal and to enable staff members to acquire new skills for which there is believed to be an active demand in the industrial sector. These objectives are often overlooked by the management. A major factor in this lack of critical examination is that techno-economic competence has not been developed as a staff function, or, if it has, it is devoted to client problems and is not applied rigorously to the analysis of in-house activities.

Criteria of Commercial Potential. In selecting internal projects the choice is often made because of intuitive scientific belief that an investigation should yield results which industry ought to be able to use. This attitude encourages technical initiative, but unless each concept is tested objectively against the limitations of those factors which must be weighed by industrial entrepreneurs, there is likely to be an avoidable waste of technical resources.

Each project should be evaluated as carefully as possible after a reasonable amount of exploratory work by six general criteria: technical feasibility, manufacturing practicality, market potential, public policies, economic justification, and entrepreneurial attractiveness. These tests should be applied progressively with increasing intensity as information is collected during the course of the investigation. If the answers are not positive at any critical point against all six criteria, the chance for eventual success is discouraging.

Technical feasibility is the first to be confirmed by small scale work in the laboratory or model shop; it defines the character of the product and the process by which it is to be made. Manufacturing practicality is initially determined by development engineers, often by pilot plant experiments, to show that a product of desired specifications can be produced by acceptable process and equipment requirements at a reasonable cost; their conclusions must in due course be checked by plant engineers and production managers. Market potential is estimated by market researchers, subject later on to

verification by sales managers who must weigh these forecasts against commercial factors affecting volume, price, and distribution system.

The test of conformance to public policies is in some cases limited to compliance with legal restrictions such as regulatory requirements and patent rights. In developing countries there is often another important factor, namely, government plans for economic development. These often include preferential listings of specific types of industries, and those which are favored frequently enjoy advantages such as development loans, tax concessions, or relaxation of restrictions on exports or imports.

Economic justification obviously hinges on comparison of estimated total costs with anticipated income to determine whether the return on investment is favorable. The analysis should go further, however, to examine the cost-benefit relationship of the given project as compared with other courses of action available to the enterprise. For example, when faced with the attractive returns for a new undertaking but at greater risk, should the management use its resources to expand its present business with lower profitability but reduced chance of failure.

Entrepreneurial attractiveness is subject to the intangible factors in the decision making processes of the managers of enterprises. While assessment of an undertaking by the criteria discussed above may be expressed in positive terms, the answer can never be free from many uncertainties about the future. Changes in internal resources due to other unforeseen commitments, and alterations in the external environment over which the enterprise itself has no control, are possibilities which have to be taken into account and allowed for by those making final choices among alternatives. While the formulation of policies for future directions of growth is a wise managerial precaution to provide general guide lines, the necessity for making a decision in each new case in the face of unpredictable hazards calls for intuitive judgment about matters for which facts are not available to permit logical processes of analysis. Hence it is desirable to expose new concepts to managers during the course of development to solicit their reactions, rather than to wait until the investigation has been completed.

Techno-economic Evaluations. Economic feasibility, including both practicality for manufacturing operations and market potential, are essential qualities of technical services. For this reason the most productive technological institutes include in their staff capabilities personnel with competence in techno-economic analysis. Two types of skills are required, namely, process engineering to study production aspects including plant costs and investment in facilities, and market research to estimate sales volume and competitive selling prices.

The simpler forms of technical services rarely require additional techno-economic analysis. Specific items of information, analyses and tests, and trouble-shooting are likely to involve only modest costs for application, and they rest on established practicality from the experience of others. Their feasibility for implementation should be obvious to the client himself. Investigations in greater depth, such as product or process development, do not enjoy such a background of reliability, and they need to be checked for economic soundness.

The more extensive projects for clients are much more valuable and credible to them if techno-economic analysis has been included in the scope. The technologists who perform the major part of the work cannot be expected to have the highly specialized skills and experience required to formulate reliable estimates of manufacturing feasibility and market prospects. Hence expert assistance as consultants on the investigations should be provided by those skilled in these disciplines. It is much better to provide these analyses from internal staff groups than to rely on outside organizations who are not so close to the detailed technical work.

Techno-economic evaluations are especially necessary for the in-house programs to ensure their practicality. The hazards of wasting much effort on activities which fail to find industrial application are obvious.

When techno-economic skills are available in a technological institute, experience shows that they become much in demand by private and public enterprises. The combination of techno-economics with a broad range of technical expertise makes them a more valuable resource, much greater than when the two types of competence are independent and separate, for entrepreneurs who wish to have comprehensive assessments

of their ideas for new ventures. There are many requests likely to come also from government for surveys of possibilities for regional or national development programs. In fact, the management of an institute often has to put limits on the amount of outside work in order to reserve sufficient time of these specialists for participation in the examination of internal activities.

The existence of a techno-economic staff usually leads also to the use of interdisciplinary teams for problem solving, the preferred managerial technique for research and development. The process engineers and market researchers collaborate intimately with technologists to guide the investigations in those directions which provide optimum reliability regarding industrial feasibility.

Stimulation of Entrepreneurial Interest. To ensure the success of in-house investigations, a few technological institutes have taken strong steps to secure the judgment and cooperation of entrepreneurs before pursuing internal projects further than preliminary study of technical, manufacturing, and marketing feasibility. To this end they insist that after their own evaluation indicates promise, some sponsor or collaborator from the industrial community, either private or public, must take an active part in planning and appraising additional work. If possible, an arrangement is made whereby sponsorship includes at least partial support of the cost. Failing even this degree of participation, an agreement is sought by which the sponsor will reimburse the institute later on out of any profits that may accrue from industrial use of the results.

The benefits of this policy go much further than mere financial contribution. After all, the institute is using general income from its founders to assist industrial development, and recovery of costs is not obligatory. The big advantage is in advice from the entrepreneur on how to ensure practicality in the program. It was pointed out earlier that internal techno-economic evaluations give only preliminary opinions of feasibility. The real test comes when an enterprise has to consider investing in implementation. Operating personnel in the entrepreneur's manufacturing and sales departments can contribute greatly to sharpening and confirming these internal estimates.

Further, industrial managers can make a better appraisal of the aspects of public interest and over-all economic values. And finally, unless someone takes active entrepreneurial interest, it is very unlikely that the project will be put to any commercial use.

The plea is often made that if a project has good technical justification, sooner or later some industrial organization will apply the results. This premise is faulty because the scope of the work must be designed for a particular situation. While the investigators have acquired knowledge and skill in carrying out the work, in practice much of the study will have to be done over again before it can be adopted for a commercial operation, for which not only the economic conditions but also the technical requirements may have changed considerably in the interim.

III. MANAGERIAL CHARACTERISTICS AND POSTURE

The preceding discussion has been concerned with the direct results of operations, some of which can be subjected to quantifying procedures, although the interpretation of the data in terms of comparative performance must be a matter of opinion.

This section is addressed to the intangibles of managerial policies and practice. While they cannot be expressed quantitatively, they are, nevertheless, of vital importance. They underlie the reasons for past performance and they provide the basis for a more productive future.

The managerial aspects of an organization will be discussed under the following topics:

1. Organizational Characteristics.

Most technological institutes operate under a quite broad charter which provides leeway in developing diversified operations. This charter should be examined for undue restrictions on the freedom of the Board of Directors and the Executive Staff to expand the fields of service and technical competence in accordance with the apparent needs of the industrial community which they serve.

A reasonable degree of autonomy is essential, and requirements for detailed supervision by any outside agencies is undesirable. Personnel policies and financial control should be such that the responsible management is able to recruit and retain competent staff and to use them flexibly for accomplishment of the objectives.

2. Managerial Climate.

Prime responsibility rests on the Board of Directors which sets general policies, appoints an executive staff, and provides general overseeing, but not detailed supervision, of all operations. It should have adequate representation of the industrial and financial communities and should not be dominated by appointees of government departments. The members of the Board, which should be of reasonable size with only periodic meetings, should serve on a part-time volunteer basis. They should be more concerned with stimulating the performance and growth of the organization than with direct control of the Executive Staff. If the Board becomes dissatisfied with performance, their recourse is to make changes in the Executive Staff rather than to do more detailed supervision.

The Director or Chief Executive is the most important element in the management and hence in the success of the organization. Great attention should be given to his selection by the Board to make sure that his managerial and professional abilities are equal to the task of assembling and leading a body of competent diversified specialists. He should be able to delegate responsibility and authority for the details of organizing and supervising operations so that he can devote the necessary efforts to policy formulation, planning, and the cultivation of high level contacts in industry, finance, and government. In most technological institutes in developing countries the Director is forced to pay too much attention to minor matters and decisions which could best be handled by other senior personnel.

The Director should have authority, subject to approval of the Board of Directors, to select members of his Executive Staff. If this freedom is restricted by outside interference, he cannot logically be held responsible for their performance in carrying out loyally, the policies which he adopts, usually after consultation with them. The

The Board of Directors should preserve the integrity of his administrative powers.

3. Personnel Administration

One of the major problems of technological institutes in developing countries is the ability to set salary and benefit scales which enable them to retain experienced personnel, particularly in the middle brackets. The appraisal of the effect of existing policies starts with an analysis of the composition of the staff and the rate of turnover at different levels for a period of years. A situation in which there is a small number of individuals with several years of experience, a deficiency at middle echelons of responsibility, and a rapid turnover of personnel with, say, less than six years of tenure, indicates usually that financial rewards are inadequate, although the possibility that there may be other reasons should not be overlooked. Positions in industry are often better paid, and they attract many promising younger men away from institutes; while this transfer ensures a flow of experienced engineers and technologists into private and public enterprises, which should be an institutional objective, excessive flow poses severe difficulties to the institutes themselves.

Factual information about comparative salaries and benefits in government, industrial, institutional, and university employment is seldom available. Rumors often distort the actual situation. Nationwide surveys of remuneration of professional workers are urgently needed to establish an equitable basis for salaries.

In addition to pay, opportunities for professional development are also an inducement, and the nature of these programs in an institute should be appraised. Many of these organizations are able to arrange training courses or scholarships abroad. Also common are relationships with neighbouring universities by which, on a part-time basis, senior staff members may teach and juniors may pursue advanced study. Sometimes special courses are offered internally. Rarely is there any systematic attempt to provide training in the management of technical activities.

4. Organizational Structure.

The formal organization of an institute is much less important than the manner in which it actually operates. Most of them follow classical

patterns of subdivision by discipline, type of activity, or sector of industry and often there is a combination.

The important issue is whether there is a rigidly cellular atmosphere, or whether communication across formal structures is encouraged or at least permitted. Many institutes in developing countries go so far as to use interdisciplinary teams in the modern sense.

5. Operating Principles

The use of a project system is highly desirable. The degree to which individual work assignments are defined, programmed, justified, and controlled, is the most important index of quality of management. Unless the program is organized and supervised in some suitable manner to permit logical deployment of resources of technical personnel, much effort is sure to be wasted. Attention to distribution of time on activities other than the technical program is also essential.

6. Planning.

Institutes which allow their activities to be governed solely by haphazard response to external pressures are not being properly managed. Instead, the administration should develop a systematic plan for growth in those directions which are set as objectives by the Executive Staff with the approval of the Board of Directors. Unless a long range perspective of reasonable flexibility is in evidence, the management is not living up to its responsibilities. Further, the general principles of these growth policies should be made known to the rest of the staff, so that they can feel a sense of purpose in the organization rather than direction by arbitrary decisions.

The holding of periodic general staff meetings to review past performance and future prospects is a sign of considerate management, interested in organizational morale. The use of ad hoc teams or committees to participate in certain administrative functions, such as safety precautions or library acquisitions, is a good device for giving the staff an appreciation of managerial problems and a better participation in the welfare of the organization as a whole. Above all, a system for recognizing meritorious individual performance is highly desirable.

7. Project Selection.

A systematic procedure for selection and review of areas of work is essential to good administration. It aids the development of morale in the organization. A standard form of project outline is recommended. This should include the title, objective, justification, work outline, proposed budget of time to be devoted by personnel and total cost, reporting schedule, designation of supervisory responsibility, target date, and signatures of those authorizing the work.

A suggestion system for submission of ideas for new projects by any member of the staff is used by some organizations with good results. It develops initiative and imagination among the technical personnel. When such a system is adopted, however, it is essential that concepts submitted be promptly reviewed and that decisions of action taken be communicated to those who made the proposals. The use of a reviewing committee rather than a single individual ensures more objective consideration and better acceptance of the decisions.

8. Managerial Control.

Good management requires attention to planned expenditure of effort on different projects and supervision to ensure that the plans for allocation of time are observed; the schedules of effort should be flexible to permit changes in the light of the progress of the investigations. Failure to observe these precautions is often noted in control of work for clients, but the important thing is for them to be satisfied with the results, irrespective of budget over-runs. Lack of attention to amount of effort expended and to target dates are the rule rather than the exception in many institutes on their in-house projects. These are allowed to run on for long periods without checking whether the progress still justified continuation.

Some form of measure of effort expended is essential, and this is most conveniently provided by time cards in which each staff member reports periodically on how his effort has been used. The time interval to be recorded varies, but the most satisfactory scheme is to report actual man-hours expended in different lines of work.

Time allocation should also include non-project or overhead activities. These can consume unduly large numbers of man-hours, with diminished accomplishment on the main objectives of the organization unless attention is paid to them. The titles for reporting may include illness and personal affairs, participation in general technical activities, library reading not connected with projects, entertaining visitors, and the like.

Time card systems fall into disrepute among the staff unless the management gives direct evidence that it is using those records for control purposes. An occasional staff meeting to discuss the allocation of effort of the entire organization is a good procedure.

IV. SUMMARY OF MAJOR POINTS TO BE COVERED IN AN EVALUATION

Below are listed, in the form of questions, the major aspects of a technological institute to be covered in a systematic evaluation. The answers should be framed in qualitative terms, such as, excellent, satisfactory, or deficient. It is inappropriate to try to express the opinions in numerical terms because it would imply an accuracy which the data does not warrant. The ratings should be based on the performance of the organization within its technical and economic environment, and should not be based on a theoretical ideal.

General Objectives of Evaluation

Because an appraisal of this type covers such a variety of detail, the major purpose may be overlooked. The essential points to be answered may be framed as four basic questions, viz:

1. What are the real needs for technical services of the community which the institute is supposed to serve?
2. Is the programme suitable for meeting these needs in a practical way?
3. Is the management of activities conducted in such a manner as to bring about optimum use of institutional resources of skills and facilities in carrying out the programme?
4. Are there adequate channels of communication with the industrial sector to encourage practical application of the results?

Charter

Are the scope and flexibility of the formal document for the foundation and operation of the institute adapted to modification of the programme to meet industrial needs? Is there a reasonable degree of autonomy? Are there restrictions which hamper expansion and growth?

Board of Directors

Does its composition represent the major industrial interests of the community which the institute is designed to serve? Are its size and schedule of meetings suitable for carrying out its functions efficiently?

Do the Members confine their activities to formal matters or do they also use their influence to promote the range of services and contacts?

Chief Executive

Does he have freedom and authority commensurate with his responsibilities? Is he overloaded with administrative details so that he is handicapped in his functions of planning and top level representation in the community? What is his image inside the organization and among industrial managers and government officials?

Executive Staff

Are the size, prestige, and authority of this group adequate for proper internal administration and for the required external contacts?

Technical Staff

Are the qualifications, extent and diversity of the professionals' experience adequate? Is the number of staff sufficient? Does the rate of turnover and difficulty in recruitment hamper effectiveness? Are morale and productivity good? Are they competent in managing their own activities?

Programs

Are the activities broad and with proper balance for meeting the objectives of the institute? Is the work oriented toward the real needs of the industrial sector?

Administration

Is the work well organized? Is the technical staff effectively deployed? Is there adequate administrative control of programmes? Is there techno-economic capability to supplement technical expertise? Are internal communications satisfactory?

Work for Clients

Do fees from clients represent a reasonable percentage of total income? Does the rate of increase of fees over a period of years, show encouraging growth? Does the institute maintain follow-up on the use of results by industry? Are relations with clients handled satisfactorily by reporting procedures, staff contacts, and managerial relations? Are assignments for clients analysed to determine type of service, category of industry, size

of enterprise in order to determine trends?

In-House Projects

Is the major objective to develop practical concepts or new skills to fill industrial needs? Are projects selected in accordance with this concept? Is there adequate check of proposed activities with knowledgeable industrial contacts? What has been the record of commercial utilization of completed projects? Are the concepts evaluated from the techno-economic point of view, to confirm commercial feasibility? Are projects reviewed periodically to analyze the industrial justification for continuing them? Are steps taken to secure the interest and support of entrepreneurial contacts during the course of the work? Has the institute had any success in retrieving part of the cost of in-house projects from enterprises that have made practical use of the results?

Personnel Administration

Are the salaries and benefits adequate for retaining competent personnel? Is there a system of periodic reviews of performance and salary with each staff member? Is service to industry recognized in promotions as being equal in importance to scientific ability? Is there adequate opportunity for professional development? Is there a system for recognition of individual achievement? Is there a programme for developing managerial abilities?

V. MAJOR PROBLEMS IN EVALUATION

Cooperation of Management

One obstacle encountered by those interested in increasing the use of evaluation techniques by technical organisations is the negative attitude of managers themselves. It has been the encouraging experience of the writer to find that directors of technological institutes in developing countries appear to be quite open minded in this respect. As they are very conscious of the difficult problems they face in carrying out their responsibilities, they are usually receptive to the idea that good ideas for the improvement

of their operations can come from outside sources.

The subject of managerial complacency nevertheless deserves attention. In technical organizations, the executive group may be of the opinion that they are doing everything possible to manage the programme effectively. Any shortcomings are attributed to "factors beyond their control". In particular, they complain that operating executives in industry fail to make adequate use of their services, especially for the long range innovative projects which they prefer.

This attitude may be encountered in all countries, both highly industrialised and developing. Rationalization of adverse situations by shifting responsibility is a common human frailty. An individual or group which has created an operating system can be expected to defend its position. Because outside pressure is often necessary to induce managers to submit to independent appraisal, more subtle means are needed to soften this resistance to the possibility of constructive criticism.

This defensive posture arises in part because many technical directors have had little exposure to the management sciences, which have been influential in convincing executives of the value of disinterested opinion. The increase in independent management consultation has been striking, and its practitioners are in demand by even large and successful organisations.

The growth in literature on the managerial problems of technological institutes in developing countries has been helpful by predisposing many of their executives toward new concepts of administration. UNIDO has been a major source of these publications.

Self-Appraisal

In this favourable climate, therefore, the difficulty is not so much to create acceptance of the need for evaluation, as it is to find practical ways for doing it. An appraisal project may involve considerable expense, is by no means easy to staff properly, and requires much effort and willingness from the staff of the institution to assemble the required information.

Evaluation of a technological institute by its own management should be going on continuously as part of the control and planning process. The procedures outlined in preceding sections can be used as the basis for internal appraisal, although it is admittedly difficult for an administrator

to show the same degree of objectivity in assessing his own program as is expected from an outsider.

One means of securing more valid opinions internally is to provide a factual basis for comparison with the performance of other similar organizations. A useful project for UNIDO would be to sponsor a task force of directors of technological institutes to develop a uniform system for examining the results of their operations. This co-operative effort would establish a common check-list which could be used by the participants for interpreting their own situations in relation to the individual technological and economic environments.

A less direct measure for encouraging better self-appraisal is to stimulate more meetings among directors of technological institutes to consider common problems of administration. The benefits of discussions of this type, a number of which have been sponsored by UNIDO, were recognized in the United States shortly after the First World War. In recent years several associations of technical directors have been organized in Western Europe.

Personnel Selection for Evaluation Projects

An increasing number of research executives from industrialized nations have become experienced in the technical problems of developing countries. They are happy to serve on evaluation projects if arrangements can be worked out for their participation. Because of the expense of travel and subsistence, the number of cases in which their expertise has been used is rather limited. Several studies have been carried out under the auspices of UNIDO and UNDP in instances where they have been providing technical assistance.

Many more appraisals should be carried out with personnel who are more readily available. The managerial competence of technical directors in developing countries is an important resource. The formation of regional groups of executives of technological institutes should be encouraged. They could carry out evaluations of other organizations on a reciprocal basis. Although they may not have as broad experience as individuals from industrialized countries, they have more detailed acquaintance with conditions in the developing world. Serving on appraisal projects would give them perspective

for studying their internal problems.

Alternative sources of local personnel should not be neglected. Technical directors from larger industrial enterprises may be available to serve in this worthy cause. Members of university faculties with industrial experience or executives of other research groups should be considered. Ad hoc committees from the Board of Directors could be used. If there is an earnest desire by the management of a technological institute to obtain the benefit of outside opinion, all possible arrangements should be considered.

Assembly of Information to facilitate Appraisal

Participants in appraisals can carry out their studies much more effectively if they are provided in advance with pertinent information which they can digest before beginning their field work. Even when they request this preliminary assistance, however, it is rarely that they get as much as they would like to have.

A good project for UNIDO to sponsor would be a task force of directors of technological institutes to prepare a descriptive list of desirable information which they think would be feasible to provide. This outline would also assist them in organizing their internal data for self-appraisal.

The following list is offered as a suggestion. It should be pointed out that the type of financial information is oriented toward managerial use, and may be in different form from that normally compiled for accounting purposes.

- a. Official charter
- b. Organization chart, with added notation of numbers of professional and non-professional personnel in each administrative group
- c. Brief professional biographies of key personnel
- d. Summary statements of income for a period of three years broken down by major sources
Number of client projects carried out during the three year period, broken down into types of activities
- e. Income from clients during the same period, broken down into type of activity, including average percentage increase per year
- f. Brief summary of known industrial applications of results on client projects
- g. Standard or typical form of project outline used for internal work

- h. Break-down of major in-house projects by subject for three year period, showing numbers of man-weeks devoted to each since initiation
- i. Brief summary of known use by industry of in-house activities.

Guide Lines for carrying out Appraisals

Certain precautions should be observed by the individuals during the course of an evaluation. Major points are listed below.

The project is for the benefit of the management of the organization, and the study should be made in an atmosphere of friendly co-operation. It should not be in the nature of an inquisition. If the right spirit is maintained, the recommendations are more acceptable, and indeed implementation may be started before the final report is submitted.

The orientation of all discussions should be toward constructive suggestions and not toward criticism of past policies and practices.

The purpose of the appraisal should be made known to the entire organization so that they will not be apprehensive and take a defensive attitude.

All interviews with individuals should be in a kindly atmosphere, their statements should be kept in strict confidence, and no references in discussions with the management should reveal the source of adverse comments.

Most individual interviews will require an average of about one hour; senior members of the staff should be interviewed more than once. Four or five interviews per day, preferably with not more than two members of the appraisal team attending, is a reasonable schedule.

At least as much time as was spent on the collection of information and opinions will be required for study and preparation of the report of findings and recommendations; the report should be written in impersonal style, with emphasis on general principles.


VI. SUMMARY AND CONCLUSIONS

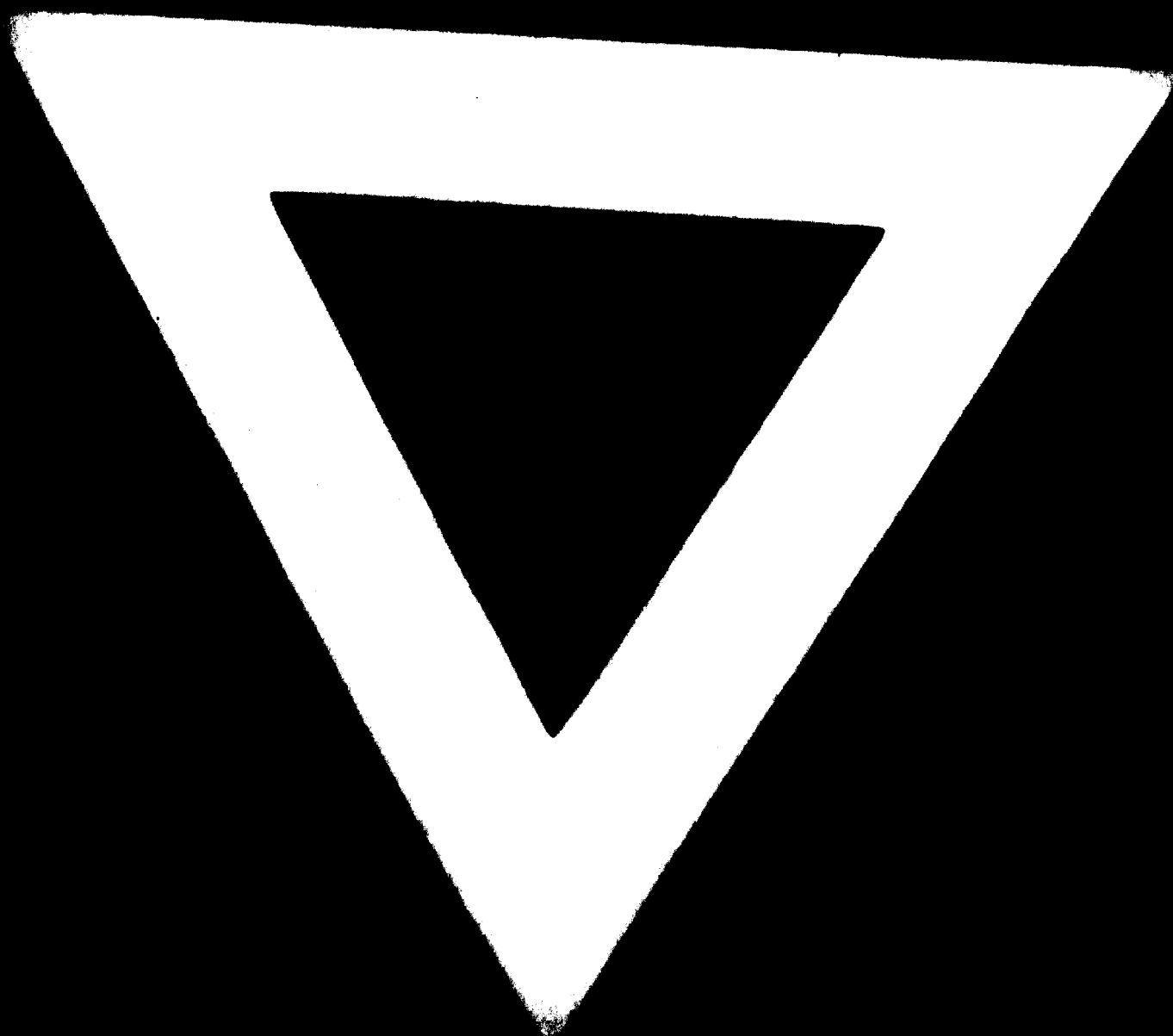
Evaluation is so widely accepted as an essential administrative function that no manager would concede its absence from his procedures, but lip service to its importance and haphazard, inchoate application are not enough.

The rightful place of evaluation should be formalized by every director of a technological institute in a developing country. He should frame criteria by which performance of technical services to stimulate industrial development can be judged. He should institute a system for the collection of factual information about all activities in a form adapted to the process of appraisal. He should set a policy of periodic assessment of all programs and administrative procedures so that their merits can be reviewed objectively. He should collect outside opinions and comparisons with similar organizations to soften internal bias.

Institute directors should examine their work for clients to determine whether it is well organized and carried out. They should pay particular attention to their in-house programs to make sure that their objectives are practical for the industrial communities which they serve; this appraisal should include not only technical feasibility but also techno-economic and commercial aspects. They should establish policies for securing the advice and co-operation of industrial managers to assist them in the direction of these projects to meet realistic goals.

Institute directors should review their administrative practices to provide optimum use of their resources. They should examine their systems for organizing projects and for allocating and controlling the skills of their staffs. They should assess their personnel policies to ensure an appropriate level of expertise and continuing professional development. They should strengthen their public relations activities in those directions that lead to a larger industrial clientele. Above all, they should analyze the pattern of their technical services to adjust it to the trends in demand from private and public enterprises.





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