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FUNCTIONS AND ORGANIZATION OF INDUSTRIAL
AND TECHNOLOGICAL RESEARCH INSTITUTES ^{1/}

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INTRODUCTION

0.1 In terms of present stage of national development, the nations of the world have been broadly categorized into developed or industrially advanced and developing, and it is accepted that a country progresses from the developing stage to the developed stage. In this process of advancing from a developing economy to a developed one, the developing country goes through two noticeable stages. The first is the stage when it is principally a producer and exporter of agricultural and mineral raw materials. At this stage, the industrial processing of its agricultural or mineral raw materials is left to other countries, and it imports the manufactured products it requires. The next stage is one in which it endeavours to put a growing proportion of its own labour into the commodities which it exports, and also meets a growing proportion of its own needs for manufactured products by means of local industry.

0.2 The process of industrialization has been recognised by developing countries as a vital requirement in the improvement of their economies. Since the populations of most developing countries are predominantly rural in character, the basic economies of these countries have been traditionally agricultural, and national planning has tended to lay more emphasis on agricultural expansion. In recent times, it has been appreciated that, to achieve balanced and speedy advancement, sound industrialization should proceed concurrently with agricultural expansion. This position is now clearly reflected in the development planning programmes of developing countries.

0.3 That industrialization depends to a large measure on technology requires no emphasis. Several international conferences held within the past few years under United Nations sponsorship on themes in the broad field of technology and development have had two common findings, namely, that the industrialization of the developed countries could be traced back to technological research and innovation, and that, for successful industrialization, it was essential that every country irrespective of size and economic situation should

have a technological organization with facilities designed to serve industry in general.

0.4 It has thus been established that every developing country requires a national technological capability sufficient to enable it to exploit effectively its available resources, and to make the most productive use of the world's store of technological knowledge for the benefit of the country.

1. INDUSTRIAL AND TECHNOLOGICAL RESEARCH

1.1 Because of its rather academic origins, research was for some time considered best left in the domain of individual scientists and technologists often located in Universities. In more recent times, however, it has been found to be advantageous to institutionalize the conduct of applied research; and as a result, institutes of industrial and technological research have been established. In developing countries these institutes are usually national institutions and are thus sensitive to the problems of local industry and identify themselves with national policies on economic development. As these institutes are usually composed of and work through teams of diversified scientific and technological personnel, they have a greater potential for problem solving than individual experts working separately.

1.2 Briefly stated, the broad aims of industrial and technological research are:-

- to create new technology
- to adapt known technology to local conditions
- to maintain processes and operations in industry, either created or adapted, at a high level of efficiency.

1.3 These objectives can be obtained in a number of ways, some of which are:-

- through applied research, to discover new processes and methods which promote the expansion of existing industries or the development of new ones
- through applied research, to improve technical processes

- through applied research, to enable better use of raw materials or waste products
- studies to adapt known processes of operation to local conditions
- industrial testing and quality control.

II FUNCTIONS OF INDUSTRIAL RESEARCH INSTITUTE

2.1 It is difficult for a country, particularly a developing one, that does not itself possess that national technological capability in terms of scientific manpower and facilities which an industrial research institute provides, to know what usable technology exists elsewhere, to understand it, to adapt it to its special needs or peculiar conditions, or even to operate, repair and maintain the necessary equipment. The industrial research institute plays a vital role in achieving sound industrial development in the country. Its impact on the country in this regard may be summarized simply thus:

- it enables industries to do better at something on which they are already engaged
- it provides information for embarking on new activities.

2.2 From this simplified statement, it is easy to identify the functions of the industrial research institute. In broad outline, these may be stated as follows:-

- to develop new materials, processes or devices for existing or new industries
- to develop new uses for existing materials
- to improve the quality of products
- to assist in standardization

2.3 And from this broad outline, the following detailed activities may be listed:-

- systematic surveys of natural resources
- study/adaptation of local raw materials for industrial uses
- economic feasibility studies for industry

- provision of general services to industry such as analysis, standardization and quality control
- selection or design of machinery to be used in industry
- technical development of production processes
- application of new processes on an industrial scale after successful pilot plant tests
- technical assistance to industry through visits to plants
- training of scientific and technical staff for industrial and other laboratories.

2.4 Within these functions and activities, the areas of emphasis and concentration as well as the priorities will, of course, vary among industrial research institutes in different countries. These will be in relation to the practical needs and requirements of industrial development in the country concerned. They will be dictated by the general economic situation of the country and its industrial development objectives. For example, most developing countries of the world, in their industrialization programmes, have identified two main areas of activity, namely

- the production of import substitutes
- the manufacture of products for export.

The activities of industrial and technological research institutes in these countries will therefore have to be fully associated with these declared objectives of national industrial development.

2.5 Again, since most developing countries are at the early stages of industrialization, the industrial research institutes in such countries will have to lay emphasis on those functions which are of a technical service nature such as testing and analysis of materials, product quality control, checking and calibrating simple equipment, and equipment maintenance and repair; and as an underlying and continuing activity the systematic

surveys of natural resources and raw materials.

2.6 To be effective, industrial and technological research institutes in developing countries should ensure that their functions meet two requirements. Firstly, their facilities, both in equipment and technical skill, should be concentrated on solving specific problems of industry, however rudimentary these are scientifically, and in translating these solutions into applications that will lead to improvement in the industrial sector. Secondly, their approach in all their work on the problems of industry should take due cognisance of the economic, technical and social conditions in the country. It is perhaps needless to say that developing a technology which local industry is unable, for economic, technical or social reasons, to absorb is so much wasted effort. Technology developed or adapted must be responsive to the immediate needs of local industry.

2.7 For most of the developing countries, it is advisable that the industrial research institute perform the standardization function, at least at the initial stages. As industry grows and the needs for quality control become complex, a National Standards Body can be established to be the legal authority for the establishment and promulgation of national standards and for fulfilling the country's role in the activities of the International Organization for Standardization (ISO). Since the scientific communities in these countries are usually small, and having regard to the type of technical expertise and facilities usually available at the industrial research institute, the institute should continue to perform the technical aspects of standardization, such as operating on the technical committees that prepare standards, and playing a key role in laboratory work required in standardization. Also, in view of the high cost, in foreign exchange, of laboratory equipment, and the fact that most developing countries persistently have serious foreign exchange shortages, it would be wise for separate National Standards Bodies to adopt a system of calling on existing equipped laboratories, such as those of industrial research institutes

and universities, to perform testing and other laboratory functions for them on an agency basis, rather than the Standards Bodies acquiring full complements of laboratory facilities themselves.

III ORGANIZATION OF INDUSTRIAL RESEARCH INSTITUTES

3.1 Some industrial research institutes are government institutions, while others are private. The former are predominantly in the developing countries, and the latter mainly in the industrially advanced countries. Whatever the form of ownership and control, there is need for effective organization and management.

Management

3.2 Dealing principally with the majority of industrial research institutes in developing countries, these are nationally owned and mainly government financed. It has been found that the usual structure and mode of operations of government civil service, as well as civil service scales of remuneration and procedures of promotion and recognition of exemplary performance, do not allow the flexibility which is so essential for successful operations of an industrial research institute. The governments of several developing countries have accordingly established public Corporate Bodies for the management of their industrial research institutes. Some of these bodies are designated Councils for Scientific and Industrial Research, while others are called National Research Councils. These Councils have overall responsibility for the whole range of applied research and R and D.

3.3 A vital function common to these Councils is to advise their governments on scientific and technological matters affecting the utilization of the natural resources of their countries and how best scientific research can be employed in the interest of such utilization. The Councils have generally categorized general research into three broad divisions, agricultural research, industrial research and medical research. It is wise to place these Councils at par with Universities in terms of remuneration and general conditions

of service, since, in most developing countries, this enables the payment of higher salaries and other perquisites than in civil service and thus facilitates the recruitment and retention of competent personnel.

3.4 For the management of individual institutes under the Council, specific management boards are set up. These boards are composed of representatives from relevant government ministries and departments, universities, industry and user agencies. As an example, the terms of reference of Management Boards of the Institutes of the Ghana Council for Scientific and Industrial Research are here reproduced:-

- the consideration and approval of research programmes drawn up by the Director of the Institute for submission to the Council, after taking into account the needs of user agencies and national development programmes,
- periodic review of the progress of the research programmes being carried out at the institute, and the results achieved;
- consideration of the budgetary implications of these programmes and projects, including the requirements for staff, equipment, supplies and capital development,
- supervision of the finances of the Institute in accordance with the financial regulations of the Council by periodically reviewing the accounts;
- the management of the estate and properties of the Institute on behalf of the Council,
- review of the reports and draft budget estimates prepared by the Director of the Institute before they are submitted to the Council;
- appointment of specified grades of junior staff of the Institute in accordance with the regulations laid down by the Council;

- ensuring the proper execution of capital development projects in accordance with the regulations laid down by the Council;
- discharge of such other duties as may be assigned to it by the Council from time to time.

3.5 The Chief Executive of the Institute is often called the Director. He sits with Management, and is responsible for the successful control of the operations of the Institute. Many qualities are required in a Director of an industrial research institute. A few of the more important qualifications are as follows: he should possess advanced qualifications in science or engineering, and an impressive record of achievements; he should have good qualities of leadership, and be a good judge of men; he should have considerable administrative experience and some business orientation; he should have reasonably good public relations qualities.

Structure of Institute

3.6 Some institutes are structured into four broad divisions:-

- Engineering Sciences
- Physical Sciences
- Life Sciences
- Techno-economic Sciences

3.7 Whatever the basis or form of divisions, it is important to inculcate into research personnel that these are not watertight compartments. Industrial research is always best performed through team-work. When projects are identified, appropriate teams made up of personnel with the requisite disciplines are assembled from the various divisions to work on the problems, each team under a team-leader.

Staffing

3.8 For its technical work, the industrial and technological research institute will have its cadre of scientists and engineers supported by an appropriate number of technicians and

other sub-professionals. With regard to the professional staff, it is wrong to assume that any science graduate is automatically a potential research man. The type of scientist acceptable for research would be an honours graduate in those disciplines most relevant, namely, chemistry, engineering, physics, with a post-graduate degree or research training in an applied scientific field and at least two years in an industry of determined specialization or an industrial research institute. It is necessary that the applied scientist should have had prior university training in research methods and techniques. It is also necessary that as soon as practicable after this he should be exposed to the industrial disciplines of time, money and reward.

3.9 It is also wise to employ not only scientists and engineers to do technical development and industrial information work, but also social scientists to analyse costs and markets and to find appropriate means of selling the research and development outputs. Applying science for growth requires attention to the two faces of innovation - technical and social.

3.10 The disciplines of technicians required will be determined by the needs of industry and the types of professional personnel employed, while the numbers of these technicians will be influenced by factors such as the shift in emphasis between the research and technical service activities of the institute. It is not possible to set down any hard and fast rules regarding the proportions between professional staff and supporting technicians. These vary among countries depending on local conditions. A ratio of two or three technicians to one professional has been found appropriate.

3.11 The normal "house-keeping" functions in an institute require an Administration division, which will handle administrative, personnel, stores and purchasing duties and will also include an Accounts section for effective financial control. Sight should also not be lost of effective public relations duties, and it is advisable that the Director be personally involved in these duties.

IV. ORGANIZATIONAL LINKS OUTSIDE THE INSTITUTE

Industry

4.1 The industrial and technological research institute loses much of its effectiveness through a lack of communication between itself and industry, and also through a lack of appreciation by industry of the value of its services. There is need to improve communications between the two and thus succeed in "breaking the ice" between them. This can best be done by instituting regular links. The institute needs to have an industrial liaison unit staffed with a few professionals who, although they have a general technical background, are not practising research workers, but are sales-oriented.

4.2 Additionally, visits of research technologists and scientists to the unsophisticated and often crude facilities in village industries in order to demonstrate practically the introduction of improved technologies have a great benefit in establishing person-to-person contact between the institute and the factory operator.

Universities

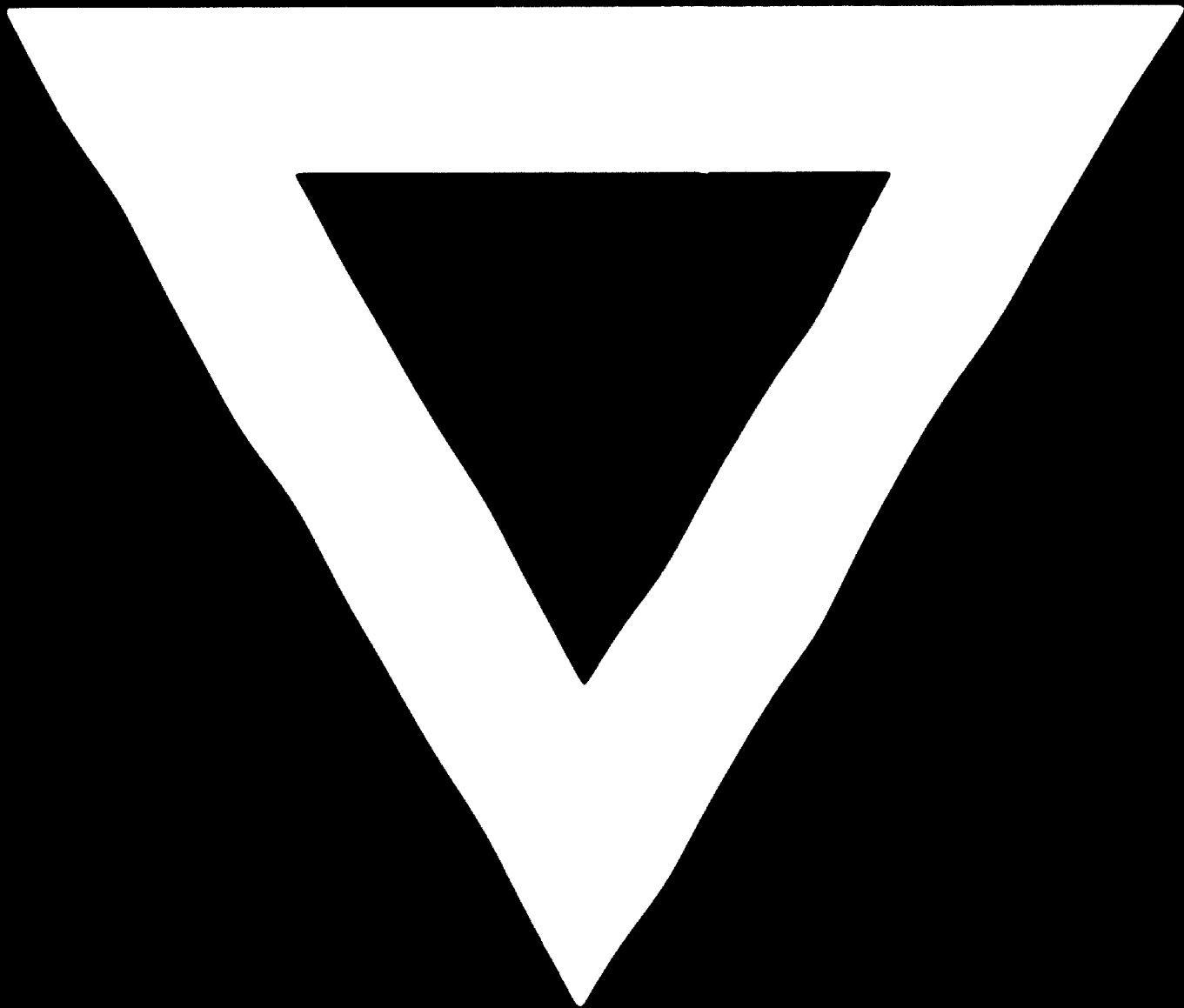
4.3 Regular contacts should be organized between the institute and relevant departments in universities in the country. The principal functions of the university and the institute are complementary, the one being advanced teaching and research for opening new factories of knowledge, and the other application of technology for the advancement of industrial development. The result of the activities of a university department could well be the beginning of the development of technology for industry in an institute. Conversely, the development of a technology in an institute could be fed into a university to enhance its teaching and fundamental research activities. Other mutual benefits from such links are in the fields of technical training, development of university syllabuses, the development of suitable skills, and the sharing of specialized equipment and expertise.

International

4.4 A successful way of building up to scientific maturity in an institution

in a developing country is to develop links for it with a counterpart in a developed country. A link between the industrial research institute in a developing country and a similar one in an industrially advanced country yields positive results. Also among the developing countries, there are differences in the level of accumulation of research results and technology both local and imported. When this situation is viewed in relation to the general similarities in climatic conditions, raw material characteristics labour supply, and capital availability in these countries, it is clear that an effective system of interchange of technological experiences between developing countries would be most beneficial for the economic development of these countries. Links should therefore be forged between industrial research institutes in developing countries and similar ones in advanced countries as well as among the developing countries themselves. The World Association of Industrial and Technological Research Organizations (WAITRO) has a programme for promoting effective linkages between industrial and technological research institutes.





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