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08141



United Nations Industrial Development Organization

Distr.  
LIMITED

ID/WG.278/1  
2 June 1978

ENGLISH

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Expert Group Meeting on the Role of  
Industrial Consultancy in Developing Countries  
Ljubljana, Yugoslavia, 26 - 30 June 1978

CONSULTANCY AND ENGINEERING ACTIVITIES IN DEVELOPING COUNTRIES AND  
THEIR ROLE IN ECONOMIC AND INDUSTRIAL DEVELOPMENT\*

by

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# I. ROLE AND RATIONALE OF NATIONAL INDUSTRIAL CONSULTANCY SERVICES FOR DEVELOPMENT

## 1.1 The Need

The establishment and upgrading of the Consulting and Engineering capabilities in Developing Countries would have no justification unless it is demonstrated that such capability is vital in contributing significantly to a rational and logical, industrial and economic growth. What is desirable and what is indeed of concern to most Developing Countries is an urge for generating thrust towards betterment of the living conditions of its population and more equitable distribution of wealth in the country. A very important vehicle for achieving these desirable goals is that of an appropriate industrial and technological development. The extent to which the Consulting, Engineering and related capability indigenous to a country can make useful and significant contribution to this pattern of industrial and economic growth, will determine the importance of the development of such capability.

## 1.2 The Scope

It is felt and, indeed, proved time and time again that Consulting and Engineering activities form an interface between the planning exercise which consists in right and rational selection of projects, evaluating their economic viability and choosing the most appropriate product design and technology on the one hand and the implementation of the projects on the other, which includes detailed design and engineering, procurement of plant, equipment and machinery through invitation and evaluation of competitive bids, preparation of contract documents and

construction drawings, inspection of equipment, supervision of construction and erection, commissioning and testing of plant and equipment and its initial start-up. Indeed, the Consulting & Engineering Services go beyond the commissioning of plant and provide valuable services in proper operation and maintenance of the plant as well as services relating to training of personnel which are vital to the optimal running of the plant. Consulting and Engineering Services backed by R&D provide the necessary support to adapt and innovate imported technologies and techniques to render them appropriate to the "use environment", and also to help in the creation of new technologies indigenously which would be "custom made" and, therefore, automatically appropriate to the "end-use climate".

### 1.3 Special Significance for Developing Countries

The role that the Consultancy and Engineering organisations are called upon to play in Developing Countries is significantly different from, and much more crucial than, that of similar institutions in Developed Countries. While in the industrialised countries, major proportion of investment is for expansion of existing plants or for setting up of projects similar to those already in existence, in Developing Countries, the Consultant has to virtually start from scratch with the first grass roots project of its kind. Indeed, what adds to the complexities of this task is that the Project is to be set up in an environment and with factor endowments and proportions which do not conform to any readily available model in the industrialised countries. The paucity of information,

the sparse technological base and infant industrial culture make this task even more arduous. Finally, Consulting and Engineering Organizations in Developing Countries have to assume many of the responsibilities and take decisions which are normally discharged by the Project Owners in Developed Countries. The reason for this is that the entrepreneurs in Developing Countries, particularly those at the early stages of industrial development are, relatively inexperienced.

Similarly, indigenous capital goods industry, where it exists, being small, enjoins upon the local Consulting and Engineering firms to help and assist the fledgling capital goods industry by providing it much greater technical assistance than merely presenting it with machinery specifications and equipment tender drawings. The Consultant's role as a catalytic agent in the development of indigenous machine building capability thus assumes special significance in Developing Countries.

Local Consulting and Engineering firms can also provide useful information to indigenous research and development institutions about the type of relevant R&D projects which are needed by industry and should, therefore, be undertaken. In the reverse direction, the Consulting firms play an important role in acting as a bridge between the R&D institute and the industrial user by providing to the latter a completely engineered package based on the locally created technology.

Since intimate knowledge of local constraints and requirements are vital to the evolution of rational



project design solutions as well as appropriate technology, these could best be evolved by local Consulting and Engineering institutes in a developing country supported by R&D institutes. Where such institutions are not yet in existence, similar institutions from other Developing Countries could provide the necessary assistance which would be much more relevant since they themselves have gone through similar experiences under somewhat identical conditions of development in the not too remote past. It may well be that the institutions and organisations from two or more Developing Countries can join hands and each can provide a part of the input to make up the total package of technology, consultancy, engineering and project design services, as well as equipment and construction materials.

#### 1.4 Relevance and Benefits

The relevance of local consultancy, engineering and R&D Services in developing countries and some of the major benefits arising from such local services are discussed below :

##### i. More Appropriate Choice of Technology :

Because of their knowledge about alternative sources of technology and their capability to evaluate the application of technology in varying environments prevailing in Developing Countries, Consulting and Engineering organizations can assist the Project Owner in appropriate choice of technology, be it from overseas source or from local industrial research institutions.

##### ii. More Efficient Acquisition of Technology :

By virtue of their knowledge of alternative sources of foreign technologies, their characteristics, the global demand and supply position, Consulting and Engineering

organizations provide the necessary talent and expertise as well as the bargaining ability in negotiations for purchase of foreign technology. Disaggregation of foreign technology package by consultants leads to a better appreciation of its appropriateness as well as a more efficient selection of the components of 'technology package' which have to be purchased, the others being provided locally. This would also reduce the foreign exchange costs and at the same time ensure maximum local participation of technological and engineering inputs, machinery and equipment and constructional skills in the design of the project.

iii. Adaptation of Technology : Since imported technologies are evolved under a different set of conditions, local consultants can help not only in choosing overseas technologies from Developed Countries which are closest to the technologies most appropriate to local conditions, but also provide the requisite skills for modifying and adapting the chosen technology to render it appropriate to a given set of objectives.

iv. Absorption, Diffusion and Horizontal Transfer of Technology : In view of the considerable Project experience and awareness of the local requirements, Consulting and Engineering organizations often make the most suitable and efficient recipients of technologies acquired from other countries and their diffusion to industrial units through the means of horizontal transfer. This results not only in acquisition of suitable technologies at minimum commensurate costs, but also adaptation of such technologies so as to make them appropriate.

v. Protection against obsolete or unproven technology : Due to their experience, local consultants can safeguard entrepreneurs from acquiring obsolete technologies, inappropriate technologies and in some cases even commercially unproven technologies and thus preventing them from being used as test-benches for foreign technology supplier.

vi. Maximising Use of Indigenous Equipment, Materials and Skills : Due to their experience and knowledge of local availabilities, local Consulting Engineers can make significant contribution to the more intensive use of local, human and physical resources.

vii. Catalysts in Development of Local Industry  
By developing specifications and tender drawings for equipment around local machine building capability, local consultants can contribute significantly to the development and growth of local industries and ancillaries.

viii. Linkage to Local R&D Institutions : Local Consulting & Engineering firms can act as catalytic agents to provide basic information on the areas of relevant R&D activity to local R&D institutions and help in the utilisation of this Research & Development in the productive sectors of the economy through its commercialisation. The Consulting & Engineering firms provide the necessary inputs to engineer the local technologies into complete project packages, often supported by necessary guarantees, thus creating a measure of confidence and credibility in the minds of the users.

ix. Improved Technical Competence and Reduced Vulnerability : Through local Consulting and Engineering capability the Developing Countries can achieve improved technical competence and reduced vulnerability in technology, equipment and turnkey project purchases.

x. Technological self-reliance : By a judicious mix of the proportions of imported and indigenous components in a project and through provision of local Consulting, Design, Engineering, and R&D Services, the national technological self-reliance improves considerably as does the mutually collective self-reliance among Developing Countries through sharing of knowledge, experiences and use of a structured Consulting Engineering and other Technical Services.

xi. Catalytic Role in Exports : Consulting and Engineering organisations have to keep abreast of the equipment and machinery requirements of the various countries and industries all over the world and thus help the local machine manufacturing industry in Developing Countries to manufacture and produce goods of such specifications and quality standards as would conform to the requirements of industrialised countries. This would, in time, lead to an increased share of developed country markets for Developing Countries.

xii. More Rational Planning and Investment Decisions  
Local Consulting and Engineering Organisations with their intimate knowledge of local conditions, manufacturing capabilities, availability of material, human resources, involvement in actual implementation of earlier projects, can help, through hard data, thus collected, in macro level and sectoral planning at regional and national levels. They can provide better choices and investment decisions, realistic estimates of project costs, gestation periods, linkage requirements (raw materials, intermediates, power, transport, storage, communications etc.) and realisation of rated output capacities. They can further contribute by forecasting likely delays in project implementation due to constraints arising from available infrastructure etc. and also suggest suitable solutions for these to be overcome.

xiii. Sources of Information and Its Transference

Consulting Engineering organisations, for their very existence, depend heavily on technological, industrial and environmental information. This information base is useful in working out appropriate solutions for a given project to operate successfully in a specific environment. The documentation of such information base is a very valuable asset to the country as a whole for subsequent project planning, design and implementation.

xiv. Learning through Doing : There is no better means for development of local consultancy than by learning through doing. The use of local consulting firms for project work would thus considerably help in the growth of the local consultancy and engineering capabilities with a multiplier effect and these could be put to more effective and efficient use for the benefit of the economy and society of the country as a whole, as well as for sharing with other Developing Countries through TCDC.

xv. Innovative Capability : The local R&D institutes should take on applied research programmes aimed at improving the existing technologies in industrial units in the country and also initiate activities leading to evolution of appropriate technologies required by industrial units. It is important that the R&D work to be done should have precise objectives particularly in respect of its market and applicability. R&D that does not take into account the consumer and the problem of marketing lacks that precision of objective which could render the exercise valueless. It has even been argued by some that R&D institutions probably fail more often because of inadequate links with the market than because of inadequate links with scientific and technological expertise.

Sensitivity to demand is a key to a good R&D facility and one that enhances its importance in industry. Consulting and Engineering organisations can provide the necessary market information to the R&D Institutes to make their work sensitive to the needs of society.

#### 1.5 Cost of Developing Indigenous Consulting and Engineering Services and Benefits Derived

1.5.1 While the benefits which accrue to the industrial projects through the development of above services have been discussed above, one has also to be conscious that certain costs have to be incurred for these benefits to accrue. These costs essentially arise out of delays in project execution, possible increase in risks and in some cases possible rise in project costs. All these arise out of relative inexperience in the early stages of development of Consulting and Engineering Services. On the other hand, importing such services from developed countries in the past, has demonstrated that cost overruns and time delays have also taken place although the reason for increase in costs and lengthening of project execution time, in such instances, are due to different causes, namely, unfamiliarity with local conditions and constraints as well as tendency to transplant technologies and plant design from industrialised countries to developing countries. In the balance, the past experience justifies the assumption that perhaps risks attendant in both the alternatives are, more or less, equal and that as the indigenous Consulting and related services gather more experience, such risks reduce sharply in the case of indigenous services.

1.5.2 While it is extremely difficult to quantify the present costs to be incurred and the future benefits

expected to accrue from the establishment of local Consulting and Engineering capability in a country, it has been amply demonstrated in actual studies, as also indicated in the earlier paragraphs of this Paper, that the benefits which accrue to the country as a whole are, indeed, considerable. These lead to a measure of self-reliance and collective self-reliance among Developing Countries by means of exchange of experiences. Such services also improve technical, planning and decision-making capabilities of a country and the future dividends attendant upon such capabilities are considerable.

1.5.3 The question also arises as to who is to bear the initial costs? Should it be the entrepreneur who is setting up a project or should it be the Government? This again is a very complex problem to justify a unique answer. Perhaps, Government or Industry Associations, could set up a Fund which can partially offset increased cost, if any, which may occur through the use of local services in the initial stages.

1.5.4 It is also of significance to note that the risks associated with cost overruns and project realisation delays could be considerably reduced, if not eliminated, through TCDC whereby such Developing Countries who have acquired experience in this field, would be in a position to share their experience with other Developing Countries who are at the threshold of starting the process of industrial development. Thus, Consulting and Engineering Services of one or more Developing Countries could be utilized by another Developing Country in the spirit of mutual cooperation and aim at development of its own capabilities.

1.6 Justification for Developing Indigenous Consultancy and Other Technical Services

In view of what has been stated above, there are certainly overriding advantages for development of indigenous Consultancy and other Technical Services in Developing Countries for industrial and technological self-reliance. However, due to enormous efforts, physical and fiscal inputs necessary for the proper growth and maturity of these services as also the long gestation time involved for their development, it is essential that selective approach may be adopted for development of such services to obtain optimum utilisation within the country or a given region covering a cluster of Developing Countries. Furthermore, the strategies would undoubtedly vary and will have to be tailored to suit the needs of the country or the region concerned.



## II. SOME PROBLEMS ASSOCIATED WITH DEVELOPMENT OF LOCAL CONSULTING & ENGINEERING CAPABILITY IN DEVELOPING COUNTRIES

### 2.1 Problems of Demand

#### 2.1.1 Development Policies

(a) The direction of technical change is strongly dependent on national development policies. The possibilities of applying local Consulting and Engineering capability as well as R&D facilities to the goals of development are contingent upon the specificity and articulation of the objectives and the efficiency of administrative instruments for translating these goals into strategies and projects.

(b) Creation of local consultancy and engineering capabilities do not have the same visibility in national accounting as the CEF and tend to receive much less attention. The need for more appropriate social and economic indicators in this context is urgent.

(c) In a more market-oriented competitive environment, enterprises are faced with the need to employ the economic calculus rather than hoping for windfall under import substitution, almost regardless of what is produced or how. Often, quick and immediate benefits in this respect would tend to inhibit the use of local technical capabilities. The economic growth with social equity can be materially aided by changes in fiscal, financial and other policies with concomitant changes in the role that science and technology and local engineering and consultancy can play in technology transfer and adaptation.

#### 2.1.2 Capability Evaluation and Experience

(a) It is a paradox that in evaluating the suitability of a Local Consulting and Engineering Firm or an R&D Institute in a Developing Country, invariably, past

experience and in most cases, past identical experience is sought. Unless these fledgling institutions are entrusted with work in the first instance, it will be impossible for them to garner the experience on the basis of which their capability is sought to be evaluated for award of work. It will be desirable to break down total package of services into its various components and then evaluate the risk elements associated with each component such as Civil Engineering work, Utilities and Services, Process Engineering, Plant Engineering etc. Another approach could be that a Consultant from another Developing Country is retained to associate with the local Consulting Engineer's work in the first one or two jobs of a particular type to ensure its correctness. This would, no doubt, involve a little additional expenditure in the first instance but would be a very small price to pay for the development of competent Local Consulting Engineering profession.

(b) Often, length of experience is used as a major criterion for evaluation of the capability of a consulting and engineering organization in a developing country. It is suggested that a more rational basis would be the relevance of experience in the context of the job content as well as the environment.

(c) Similarly, the size of the overseas Consulting and Engineering Firm and the total number of personnel on its rolls is often used as a criterion for selection rather than the experience of those personnel who are intended to be deployed on the specific job.

### 2.1.3 Lack of Awareness of Local Consulting and R&D Contribution

(a) There also seems to be some doubt as to the real awareness about the contribution which Consulting and Engineering institutions make to the -

- i. Economy as a whole (Macro level : impact on more rational industrial and investment policy instruments).
- ii. Project (Micro Level : feasibility, optimal techno-economic solutions).
- iii. Sector (such as Steel, Textiles, Cement etc. Here, the contribution lies in a sectoral approach and the advantages associated with optimal use of resources and judicious economic fragmentation of product-mix among several units in the same sector).

(b) It will be useful if knowledge and information about such contributions by Consulting and Engineering organisations is compiled and persons in the decision-making positions are made aware about this. In this connection, it would be useful to have a National Association of Consulting Engineers or some such similar body to compile such studies in the manner in which Local Consultants are able to reduce costs, provide more appropriate design solutions, etc. This type of information would not only help in a greater awareness of the contribution of the Consultant within the country but such information could also be made available to other Developing Countries as a measure of Technical Co-operation among Developing Countries and could go a long way in greater use of Consultants of one Developing Country by another in association with its own Consultants.

(c) Lack of Information : Considerable gaps exist in many developing countries in respect of technologies and engineering and technical capabilities available in other developing countries. There also appears to be

a communication gap between generators of technology, namely, R&D and consulting institutions on the one hand and its end-users on the other. This is also a problem area and indicates increased use of local capabilities within a developing country as well as use of such capabilities by other developing countries.

(d) Lack of Motivation : It has been suggested in this Paper that the use of local engineering and scientific capabilities would lead to more appropriate technology and project design and engineering solutions. The ultimate motive force for use of appropriate technologies and design solutions by the potential entrepreneur depends on the market conditions. National policies have, therefore, to be devised so as to provide the necessary package of incentives and regulation for the entrepreneurs to gravitate towards increasing use of appropriate technologies and hence local technical and engineering capabilities.

#### 2.1.4 Attitude Barrier

Human resources, strictly speaking, should be considered on both sides of the technology equation - supply as well as demand. Administrators, managers and entrepreneurs, and the various levels of technical staff in production activities, all affect demand, while research scientists and engineers affect the supply position. On both sides, the quality of training and the attitudes which have been inculcated are of decisive importance.

Typically, because of the educational and training programmes through which a large proportion of such people have gone through in institutions in

developed countries, the net result is a somewhat limited interest in and appreciation of local problems and aspirations, and a strong elitist bias in favour of the latest, most sophisticated technologies developed in the industrialised countries, the most exotic scientific fashions of the day, and adoption of engineering and design solutions which are essentially suited to industrialised societies. This orientation has a strong influence on the range of possible solutions to practical problems which are seriously considered. Appropriate technologies rarely feature within this range, whether on the part of the administrator, the enterprise manager or the research scientist. There is an evident need to introduce real-life problems into training curricula, whether at vocational training level or the university level.

#### 2.1.5 Fluctuation in Workload and Limitations of Finance

(a) Fluctuation of Workload : Another problem relates to the fluctuation of workload which makes it exceedingly difficult for the Consulting Engineering Firm to carry the burden of its permanent pay roll without assurance of minimum work. This is more so with small and medium size firms. While such fluctuations in the pattern of workload are inevitable, their impact on small and medium size independent Consultant Firms in Developing Countries is almost disastrous because they have no monetary means to carry them through the lean periods. Such is not the case for large Consulting Firms who have certain sustenance power due to the financial reserves they might have built up. Such is also not the case with those Consulting Firms who are either owned by or have corporate links with equipment manufacturers, contracting agencies or process suppliers.

(b) Support from Financial Institutions : The Banks and Financial Institutions in Developing Countries do not, as a rule, provide working capital requirements of the Consulting Firms as the latter have no collateral arrangements in the form of tangible assets except the corporate trained manpower and its earning potential. This needs to be overcome if the right type of Consulting Profession is to develop, otherwise the mortality rate in the profession becomes high. What is even worse, sometimes the Consulting Firms degenerate into agents of equipment or technology suppliers thus defeating the role which they are to play in the national development. This also results in a setback to the high ethical standards and traditions which the fledgling profession in Developing Countries has to evolve for its own survival and future growth.

(c) Government Support : Active support from Government, Planning Organisations and Financial Institutions to award work relating to Feasibility Studies, Project evaluation etc. on a long term programmed basis would go a long way to sustain such firms while they are developing their expertise, experience and clientele.

(d) Insurance : While it is quite customary in developed countries for Consulting Engineers to take out an insurance policy to cover their risk, this is rarely possible in a developing country. Such an assistance extended to developing countries' Consultants by their insurance companies or banks would go a long way to nurture the fledgling profession.

#### 2.1.6 Quality Assurance

It is necessary to have quality assurance of the work of local Consulting Engineering Firms in

developing countries to inspire confidence and credibility among its users. National Associations or Institutions of Consulting Engineers could usefully fulfil this role.

## 2.2 Problems of Supply

### 2.2.1 Manpower and Expertise

(a) Lack of adequate manpower of the right calibre, experience, education and analytical skills.

(b) The extreme desirability but difficulty of quickly welding individual expertise into harmoniously functioning multi-disciplinary corporate Consultancy and Engineering teams.

(c) Attracting the right calibre of personnel since the opportunity cost of such professionals in other alternative industrial and economic activities, such as manufacturing, administration, policy making levels in the Government etc., is considerable and the emoluments and status attached to such positions are invariably higher than the Consulting and R&D Profession can afford to offer in the beginning.

### 2.2.2 Attitude of R&D Institutes

It is important to reorient the attitudes of Research and Development Institutes in developing countries to applied research, particularly in respect of pressing problems. There is a tendency to get carried away with sophisticated research programmes which have no immediate relevance except the satisfaction of publishing the results of research in prestigious scientific journals. The emphasis has, therefore, to be shifted in a very large measure to practical, need-oriented applied research.

2.2.3 Divorce between Universities and Industries

Perhaps, due to old traditions, academic institutions have, in a large measure, remained aloof from the grassroot problems in developing countries. It is vital that the talent residing in such institutions be inducted and involved in real life problems and their orientation should be changed. An intimate bond should be fostered between academic institutions on the one hand, and Consulting and Engineering organizations on the other.



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### III. SOME SUGGESTIONS FOR FOSTERING GROWTH OF CONSULTANCY AND ENGINEERING SERVICES IN DEVELOPING COUNTRIES

In order to accelerate the rational development of consultancy and engineering services in developing countries and for achieving greater self-reliance on their part, concerted efforts would be necessary on the part of such organisations themselves and through various measures at national levels, at international levels through the U.N. system and particularly UNIDO, which is specifically concerned with the industrial development activities, as well as through technical co-operation with sister developing countries. Some suggestions are discussed below.

#### A. Role of Government and its Financial and Regulatory Agencies

A clearly defined and articulated policy affirmation by the Governments that Consulting and Engineering Capabilities are essential elements of national and collective self-reliance and that such national capabilities are intrinsically responsive to a developing country's objectives for rational and viable development, would go a long way in fostering the growth and increasing use of such services.

The Governments of developing countries should recognise the consultancy and engineering profession as an 'infant industry' and deliberately foster its growth through some of the policy and regulatory mechanisms indicated below :

#### 1. Associating Local Consultants

- a) Government through its various regulating agencies, to make it mandatory, that in all project formulation and engineering jobs, a local consulting and engineering firm be always associated even where a foreign consultant has to be inducted.
- b) Government and public sector should set an example by making greater use of local consulting and engineering firms for their project work.

c) Technologies should be permitted to be imported, only if, not indigenously available, and a local Consulting and Engineering Firm be invariably associated in technology evaluation and project engineering.

2. Primary Responsibility

As far as possible, the primary responsibility for the assignment should rest with the local consulting and engineering firm, who, in turn, may seek the components of expertise as required.

3. Registration of Consultants

Government or a suitable Government agency should establish a Roster of Consulting and Engineering Firms based on information gathered through a questionnaire evaluated and updated periodically, reviewing their performance, to inspire client confidence. Alternatively, a National Consulting Association can exercise this self-disciplinary role, provided it has the necessary authority.

4. Visits Abroad for Updating Knowledge

Government may set up a fund to finance trips of consultants and R&D personnel overseas to refresh and update their knowledge of technology, design and engineering techniques, plant construction solutions etc. Visits to other developing countries in this connection would be very useful.

5. Training Programmes

Training and Development Programmes need to be evolved for Consultants and R&D personnel in association with Consulting Engineering Firms, Operating Plants and Construction Projects and Universities and Research Institutions. Government should provide full or partial funding for this purpose.

6. Links with Universities and Technical Institutes

- a) Encouragement by Universities, Industrial Enterprises, Government Institutes and Consulting Engineering firms to enable students to obtain at least one semester of on-the-job training in a consulting engineering firm, or on a construction job or inplant operation or in an R&D institution.
- b) Establish close work relationship between consulting and engineering firms and faculty and students of technical institutes and universities.

7. Publicity

Support a publication to circulate news and the latest information on various aspects of consulting, engineering and R&D activity in the country including some case studies and success stories as well as problems encountered and overcome.

8. Tax Incentives

- a) Provide tax relief to consultants on their income. The tax relief should increase, greater the proportion of work done by local consulting and engineering firm on a given assignment.
- b) Carry forward of losses by consulting and engineering firms should be permitted for 3 to 5 years for tax purposes.
- c) Tax may be calculated on the average profits of say 3 years.
- d) Generous development rebate may be allowed for expenditure incurred by a consulting and engineering firm on training and development of its manpower.
- e) Since the capital of a consulting engineering firm is its trained and experienced manpower, depreciation as a certain percentage of total annual professional wage bill may be allowed for manpower turnover and retraining. This would be analogous to depreciation allowed in industry for replacement of machinery.

- f) Some incentives be provided to the users of local technologies and consultancy services by allowing, say, twice the actual expenditure incurred for such purpose as expenditure for tax purposes.
- g) Amount paid towards consultancy services, if procured from a foreign consulting firm should not be permitted as the deductible expenditure for tax purposes, by the client, provided such capabilities exist in the country.

9. Financial Support

Easier bank credits should become available to consulting and engineering firms for their working capital requirements, since they have no physical collateral.

10. Support by Financing Institutions

- a) Development Banks and Industrial Credit Institutions particularly the Government ones - should insist that their potential loanees submit detailed Feasibility Studies prepared by local Consultants with outside assistance limited to what is considered absolutely essential. Preference in the case of outside Consultant should be invariably be given to one from a developing country.
- b) Development Banks and Industrial Credit Institutions should themselves encourage indigenously developed technologies and local consultancy services by making increasing use of local consulting and engineering firms for project evaluation and subsequent to grant of loan, for project monitoring on behalf of the bank.
- c) The valuable tool of industrial credit may be used to ensure that, as far as possible, more and more engineering work is done in the country.

d) Facilities for deferred payment should be provided to entrepreneurs using indigenous technologies and local consulting and engineering services specially for large projects.

11. R&D Fund

Large industrial and business houses can set aside from their profits R&D funds which could also be made available to the consulting and engineering firms besides R&D Institutions for development of local consultancy and R&D services. The organisations providing these funds could be given tax incentives. R&D cess/levy - on a graduated scale - could also be considered for sponsoring research projects of national importance.

12. Insurance Cover

Insurance Companies should provide insurance cover for reasonable premia to consulting and engineering firms for their work, who, in turn, can provide financial guarantees to their clients, to inspire greater confidence and credibility in the minds of the clients.

13. Long Range Planning for R&D and Consulting Engineering Capabilities

An identified plan of perspective needs of Industrial Technology and consulting and engineering capabilities should be developed where the needs are of national importance such as in the case of metallurgical and basic industries, capital goods industries etc. The Government may constitute Sectoral or industrywise development councils - may be with consultancy and engineering sub-groups - for developing such plans. Long term plan for manpower needs in this area may also be evolved.

14. Sponsoring R&D Projects

The Government may create an active Agency to promote indigenous Research and Development and should also take the lead in sponsoring applied research for public sector projects - at least during the initial period. Local Consulting and Engineering firms should be retained to translate R&D effort into commercial projects and products.

B. Measures Required at International Level

1. Pooling and Dissemination of Information

One of the main constraints to the development of indigenous Consulting and Engineering capability is lack of adequate information. International Agencies, such as the UNIDO may consider providing support in the setting up of Regional and Sub-regional Information Centres for pooling and dissemination of the following types of information :

- a) The available capabilities and capacities of Consultancy, Engineering and R&D Institutions in developing countries with their experience updated periodically.
- b) Sources of technology of major interest to developing countries available both in the industrialised countries and within the developing world.
- c) Research and Development Programmes under way in various developing countries.
- d) Experience with imported technologies and their adaptation, success stories as well as problems and pitfalls.
- e) Experience in evolving design and engineering solutions in conformity with local conditions and the methodologies adopted.
- f) Experience in product design and adaptation which may be of particular interest to more than one developing country.

The Information Bank which the UNIDO has set up may perhaps be of great help in this connection.

2. International agencies, particularly UNIDO, since it is involved in the industrial development aspects of the overall development, can provide valuable guidance, by having Detailed Studies prepared on two or three kinds of strategies for growth of Consulting profession applicable to countries at various stages of industrial development.

3. Financial Assistance

- a) Provide financial assistance for trips of Consultants overseas to update their knowledge in Design and Engineering Techniques, Plant Construction Solutions etc.
- b) Assistance to Universities, Industrial Enterprises, Government Institutes, R&D Institutions and Consulting Engineering firms to enable students to obtain at least one semester for on the job training in a Consulting Engineering Firm, R&D Institutions or Construction Job or in-plant operation. This would provide the reservoir of manpower which could be utilised later by Consulting and Engineering Firms and R&D Institutions.

4. Building-up Associated Institutions

Create, expand and upgrade existing Institutes of Consultancy, Engineering, Technology Adaptation and R&D through selective and appropriate infusion of expertise and equipment.

5. Development Programme

- a) Evolve development programmes for upgrading the skills of Consulting and Engineering professions in developing countries.
- b) Special programmes be evolved to upgrade the Technology Selection and Acquisition Capability of developing countries, through its scientific, consulting and engineering community.

6. Organisation of International Meeting and Seminars

Organise frequent meetings at Regional and International level of personnel from Consulting and Engineering Institutions to exchange their experiences. Such meetings could preferably be sectoral so that the focus is on certain specialised fields of Industry and Infrastructure. There may, however, be cases where common problems of the Consulting and Engineering professions could be discussed.

7. Publications

Pooling of knowledge in regard to design methodologies, alternative uses of construction materials in developing countries, may be organised through periodical publication as well as institutional linkages.

8. Short Listing Procedure for Internationally Funded Projects:

- a) The shortlisting of Consultants for internationally financed projects should invariably include Consultants from developing countries who have the requisite background.
- b) In selecting Consulting and Engineering Firms for internationally aided projects, greater attention should be paid on the relevance of the experience rather than its length, the experience of the personnel to be deployed on the assignment rather than the total size of the Corporate Organisation and the experience of the Consultant and Engineering Firm having worked in similar environmental condition .

C. Co-operation among Developing Countries in Consulting and Engineering: Some Suggestions

1. Twinning Arrangements

This involves pooling complementary capabilities of Local Consulting Engineering Firms with sister organisations from another developing country for joint work on project-to-project basis or on sustained basis.

2. Training

Training facilities to be provided by Consulting Engineering Firms in a developing country to the personnel of Consulting and Engineering Firms from a sister developing country.



### 3. Joint Ventures

Assistance to be provided by Consulting and Engineering Organisations in one developing country in the setting up of similar Organisations in another developing country by providing Documentation, Information and Training. The concept of joint venture in Consultancy and R&D needs to be seriously considered and supported for rapid growth of the professional competence in developing countries. Such arrangements between NIDC of India and Iran and Tanzania have proved mutually beneficial.

Joint Consulting Engineering arrangements are being explored among countries such as India-Algeria, India-Nigeria etc., would be an excellent way of transference of Consulting Engineering skills. Interesting and important example of TCDC institutions in the initiative recently taken by the Non-aligned group of countries to establish a Project Development Facility (PDF). The objective of the PDF will be to facilitate access by developing countries to technologies and technological resources that are available in other developing countries. This purpose will be served by providing project identification and feasibility study services as well as project planning, engineering, designing, implementation and evaluation services. The PDF will be financed by contributions from developing countries only and its inputs will come almost entirely from these countries.

### 4. Triangular Arrangements

In projects of high and specialised technology content where such technologies at a given period of time, are not available within the Developing World, a triangular blend could be adopted with technology being inducted from an Industrialised Country and Engineering of the Project and its Construction are accomplished through the twinning arrangements discussed earlier.

5. Availability of Information

One of the most serious handicaps to the greater use of Consulting and Engineering Services from one developing country by another, is the lack of adequate information with regard to the capacities, capabilities, available technologies, experience with imported technologies, capital goods and raw material availabilities, skill requirements, research and development programmes etc. It is vital to have an information Bank on the Sub-Regional and Regional basis in accordance with the suggestion made earlier under the role that international agencies can play.

6. Exchange of Information

- a) Getting to know one another through frequent visits and exchange of publications by Consulting and Engineering Firms in developing countries.
- b) Discussion and publications of Case Studies relating to successful technology absorption as well as problems of adaptation among Consultants and Engineering Institutions from developing countries through the medium of publications, seminars etc.

7. Regional Institutes for Technology Transfer

Regional Institutes such as UNIDO-ICRAF Technology Transfer Centre in Bangalore (India) can act as clearing house for information on TCDC and provide inputs to the global information referral system, both on technologies as well as Consulting and Engineering Capabilities.

D. What the Profession can do for itself

1. Credibility among Prospective Clients

Consulting Engineering Firms and R&D Institutions should attract the most competent and capable manpower and ensure very high standards of professional competence and conduct to establish credibility among the users of their services who are initially sceptical. This may mean more attractive remuneration to be paid to the professionals as well as a better status provided to them.

2. Sharing of Knowledge and Pooling of Expertise

A co-operative spirit should be actively cultivated amongst Consulting Engineering firms so that they are able to share and pool their knowledge, experience and personnel and thus better fulfil the requirements of a given assignment. This sharing of the scant manpower resources and experience would not only mean an improvement in the quality of services rendered but would also make an optimal, efficient and economic use of the scarce skill resources.

3. Interaction with R&D and Technical Institutes

Consulting and engineering Firms should make a determined effort to forge strong links with Universities and Technical Institutions and Industrial Research and Development Organisations through the means of interlinked professional associations or governing councils. This would ensure a more intimate contact between various institutions and break down the barrier which unfortunately, more often than not, exists between them.

4. Interface with Industry and Professional Bodies

Consulting Engineering Firms and R&D Institutions should work actively towards forming specialised industry or technology oriented professional societies in association with industries using those technologies, such as, Textiles, Cement, Machine Building Industry, Power Industry, etc. Such professional fore would provide a desirable

opportunity for a closer appreciation of the problems of that industrial sector by the Consultants. It would also lead to a better understanding on the part of industrial entrepreneurs of the manner in which local Consulting and Engineering Organisations can assist them in design and engineering of new plants or effecting improvements in existing operations.

5. National Association of Consulting Engineers

Consulting and Engineering Firms should get together and set up a strong and highly representative Association of Consulting Engineers who would look after their common problems as well as project an image of local consultancy profession on the minds of the users.

6. Code of Professional Ethics

The Association of Consulting Engineers should evolve a self-imposed code of professional conduct and ethics, to inspire confidence among the users of their services.

7. Quality Assurance

The Association should also set for its member consulting and engineering firms high standards of professional competence and conduct. This would go a long way towards finding acceptance among the users.

8. Contribution to Existing Industry

It may also be useful for the consultancy profession to launch a well conceived and well organised productivity movement aimed at improvement in the operation of existing plants and thus increasing the efficiency of existing investments. This would considerably help in bringing about quick recognition and acceptability to the fledgling consulting and engineering profession.

9. Sub-contracting Services to Overseas Consultants

Consulting and Engineering Firms should make a sustained effort to secure work as sub-contractors from foreign consulting and engineering firms from industrialised countries for projects located in the area of their operation. This would be an excellent way of learning, earning, as well as technology transfer in the field of consulting engineering itself. Cost in developing countries for detailed design and engineering, for instance, would be significantly lower than the cost in developed countries for comparable quality of work.

10. Improvement of Services through Feed Back Mechanism

A feed-back system should be organised by the Consulting and Engineering Firms to obtain the necessary and relevant information on the operation of the plants they have designed and technologies that they have used with a view to becoming aware of the operational problems that may have come up and to effect improvements.

11. Roster of Experts

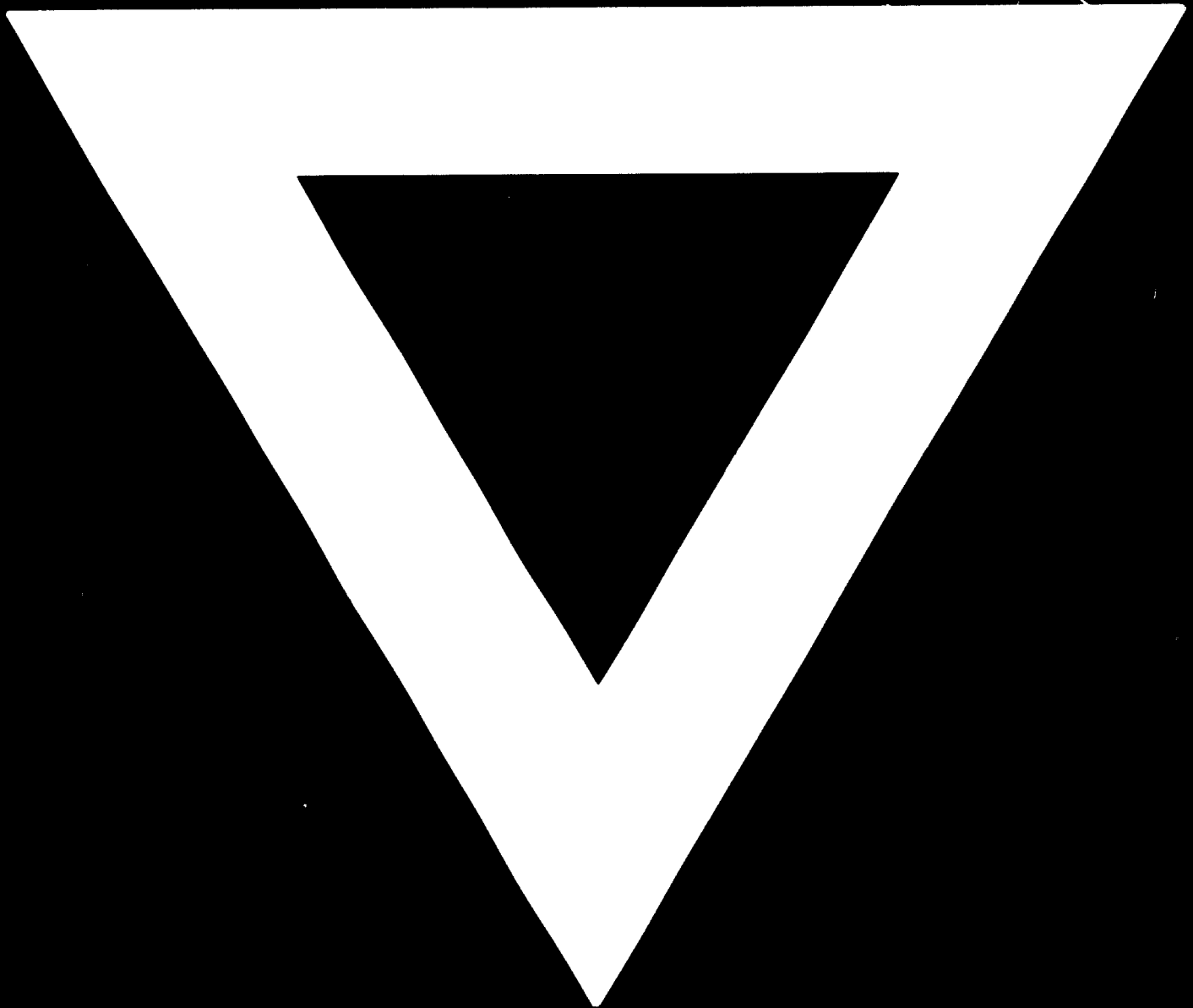
A Roster of top level experts and specialists, both in Government and private sector organisations, should be evolved so that information about the professional talents in the country in various fields of specialisations is readily available to Consultants for making use of these experts for specific assignments.

12. Foreign Languages

The R&D Institutions and Consulting and Engineering Organisations should encourage their personnel to learn foreign languages, particularly those of other developing nations, so that freer exchange of information and manpower can take place.



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