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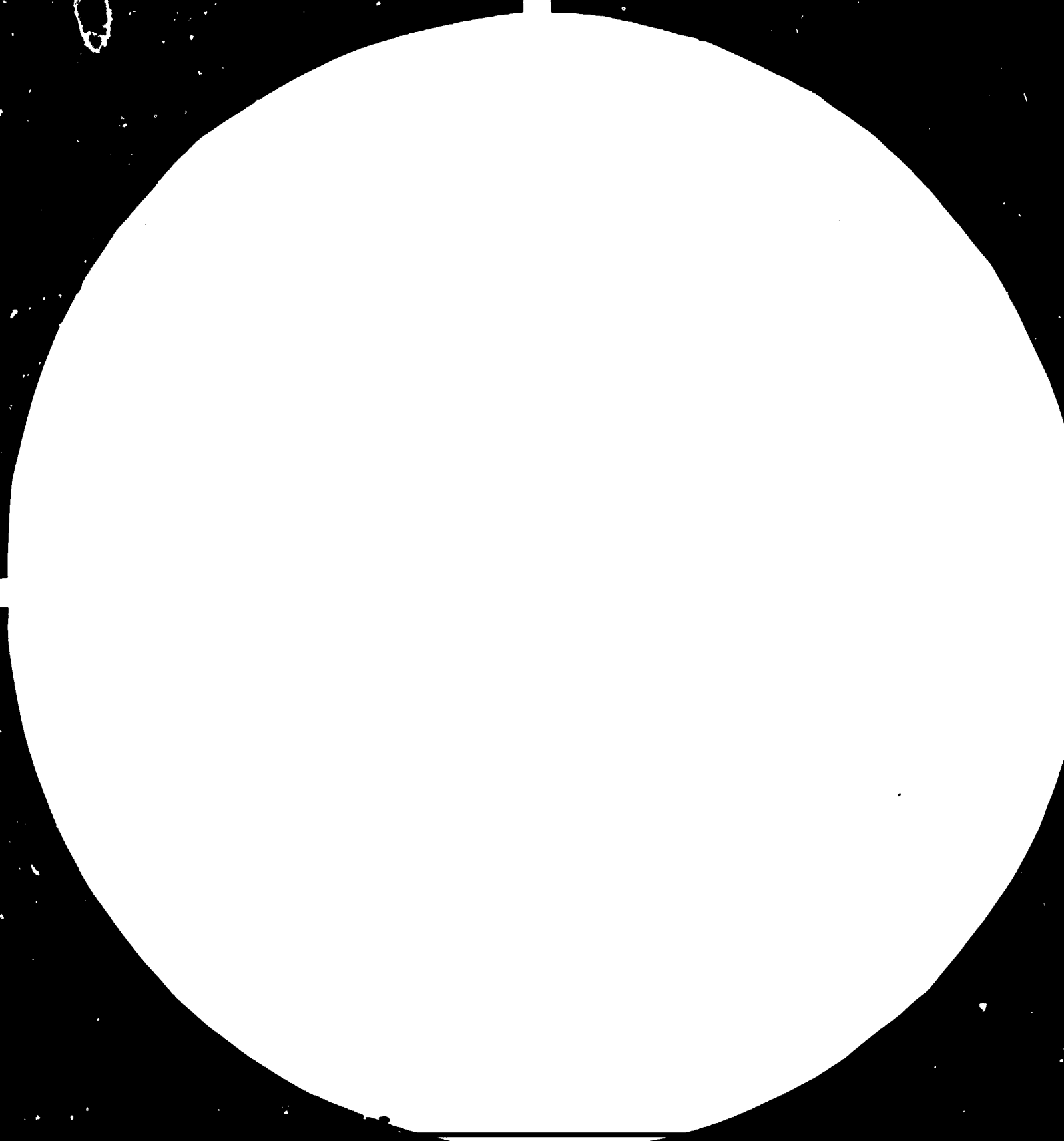
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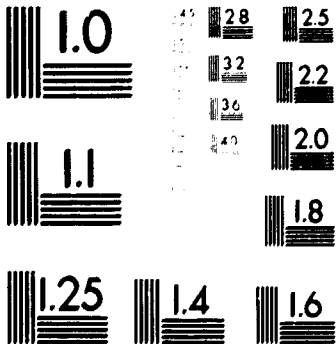
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Guide to the establishment of Industrial
Liaison Units in developing countries*

Prepared by the

Non-governmental Organizations Section

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FOREWORD

In many countries the potential for industrial development is great, but technical expertise and facilities are limited. The universities are often major repositories of both and may have a major role to play. However, between university and industry there is frequently a gap which inhibits creative interaction. The establishment of properly organized and adequately staffed Industrial Liaison Units can do much to bridge this gap and promote collaboration for the benefit of both parties and of the country itself.

This Guide has been published by UNIDO in the hope that it will assist in the establishment of such Units. In preparing it, UNIDO has drawn on the experience of several countries, whose contribution is greatly appreciated.

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CHAPTER 1

EXECUTIVE SUMMARY

Chapter 2: Opportunities and Objectives

- The need to close the gap between industry and the universities so that the expertise and resources of the latter can contribute more effectively to economic development.
- Experience in both industrialized and developing countries has demonstrated the value of Industrial Liaison Units (ILU's) in closing this gap.
- Positive attitudes on the part of both industry and academics are necessary for success.
- Most industrial problems require the application of existing knowledge rather than fundamental research; so industry can gain much from universities with only modest resources.
- Further advantages to industry include:
 - new ideas leading to greater competitiveness in world markets;
 - access to facilities such as computers and testing equipment;
 - consultancy services of academic staff;
 - improved graduate output for recruitment.
- Universities gain by having:
 - stimulus of interaction of theory and practice in curriculum and staff development;
 - contract research; supplementary to government funding;
 - income from consultancies, licensing and patents;
 - industrial training and graduate placement.

- The nation gains by the better use of scarce resources and the promotion of national development thereby.

- There are problems, for example:
 - striking the right balance between teaching/research and consultancy;
 - criteria for promotion;
 - confidentiality;
 - possible undue influence on academic freedom.

- Hence importance of:
 - formulation of policies for liaison;
 - clear statement of objectives;
 - development of appropriate institutional forms, i.e., ILU's.

- Policy issues include:
 - services to be offered to industry/university
 - costing and pricing;
 - financial arrangements;
 - allocation of income;
 - control of academic staff time;
 - ownership of property and patent rights;
 - balance between teaching, research and industrial liaison.

Chapter 3: Functions

- Functions vary; they should be based on:
 - inventory of available expertise and facilities; and
 - identification of needs and opportunities.

- Typically four major functional areas:
 - technology transfer;
 - training;
 - consultancy;
 - small business development.

- Technology transfer involves several stages:
 - research;
 - development;
 - prototype products;
 - manufacture;
 - marketing.

- Role of ILU critical, especially in early stages, either:
 - identifying industrial opportunities for exploiting university resources; or
 - identifying university resources capable of industrial application;
 - acting as intermediary, negotiating contracts, costing, pricing, licensing, patenting, monitoring progress.

- Important role also in protecting university's interests by:
 - contract terms;
 - professional negligence insurance;
 - patenting, probably through expert external agency.

- Training:
 - limited but important role of ILU in improving student output and placement;
 - substantial role in organizing and marketing post experience training for those already in employment;
 - arranging industrial training opportunities for students and involving them in projects.

- Consultancy, i.e., arranging for academic staff to offer professional advice to industry, both public and private:
 - control by ILU important in preserving balance with teaching and research;
 - in safeguarding the university against negligence;
 - in ensuring that all costs are covered and fee income properly allocated.

- Small business development:
 - matching university expertise to particular needs of small business;
 - making facilities available;
 - promoting spin-off companies;
 - possibly in science or industrial parks.

- Other possible functions:
 - maintaining appropriate data-base;
 - marketing university to industry;
 - providing industrial contacts;
 - hiring time on university equipment; e.g., computers;
 - arranging materials testing;
 - arranging industrial conferences.

- Note the importance of careful selection of functions appropriate to the resources of each individual ILU.

Chapter 4: Organization and Management

- There is no ideal model organization; each should reflect the university's own objectives, history and local situation.

- An important decision is whether to establish the ILU as a department of the university, or as a separate company. Advantages of the latter are:
 - more commercial in style;
 - less inhibited by academic procedures such as salary levels;
 - limited liability;
 - university has more protection against negligence and mistakes;
 - industry may prefer dealing with familiar form of organization.

- Disadvantages are:
 - university has less control over ILU and its activities;
 - and may not have the benefit of non-profit making liaison activities.

- On balance, internal ILU probably more suited to developing countries.

- Another policy question is whether to make the use of the ILU compulsory for all industrial liaison activities. Advantages are:
 - university may have better control over, for example, staff time spent on consultancy and income deriving from it;
 - greater consistency of practice;
 - more protection against negligence by staff;
 - university's reputation and interests better safeguarded;
 - university's commitment to liaison clearly articulated.

- Disadvantages are:
 - bureaucratic procedures;
 - complacency in ILU resulting from its monopoly position;
 - resentment by academic staff.

- On balance, the compulsory method is probably better for most developing countries.

- Staffing of the ILU is of critical importance:
 - board of management consisting of senior academic and industrial members including the chief executive of the university;
 - director of the ILU needs to be senior, essentially a marketing man, a good communicator, creative and capable of exercising sound managerial control;
 - ILU's should not be allowed to become large and bureaucratic, but a small professional and secretarial staff is needed to support the director.

- Efficient management of the ILU is essential for success; problems include:
 - coping with the different time scales of university and industry, the latter requiring quick results delivered on schedule;
 - reconciling the differing objectives of university and industry;
 - maintaining good will between ILU and rest of university;
 - ensuring that financial procedures are meticulously followed and are consistent with university policy on, for example, allocation of fee income;
 - identifying the expertise and facilities available within the university for industrial liaison;
 - researching the market for new opportunities for liaison;
 - closing the credibility gap between university and industry;
 - assembling the academic team and ensuring that they clearly understand what is involved;
 - drawing up a contract which adequately protects the interests of the university and its staff, e.g., in matters of licensing and patenting;
 - monitoring the progress of projects from inception to final payment on completion, on schedule.

- Financial management of the ILU is an important and sensitive area:
 - should the ILU be subsidized or required to be self-financing or profit-making?

- need to provide for the non-income generating activities of the ILU;
 - accurate costing, commercial charging, and efficient financial control are essential.
- Nevertheless, the overriding importance of effective marketing must not be prejudiced by excessively conservative financial controls. The ultimate criterion of good management is not merely covering full costs but also generating an appropriate surplus.

Chapter 5: National and International Co-operation and the Role of UNIDO

- In view of the need for increased university-industry collaboration and the limited resources in developing countries, co-operation on the national and international levels is important.
- The experience even in industrialized countries suggests that there is usually a need for government support in the developmental period of establishing ILU's.
- In developing countries the case for government support for promoting university-industry liaison is even stronger because:
 - the developmental phase in which earned income is unlikely to cover full costs is likely to be longer;
 - the need to give subsidized assistance to small business is greater;
 - government policies for social and economic development usually require the provision of services at less than full cost charges.
- In countries where there is more than one university, collaboration between ILU's is desirable because:
 - common services can be provided;
 - specialist expertise can be centralized;
 - the various ILU's can specialize in certain areas, either geographical or functional;
 - the case for assistance from government or international agencies is strengthened.

- International and regional co-operation can be useful, for example:
 - exchange of information and experience through workshops;
 - staff development by way of exchanges;
 - provision of consultants.

- UNIDO and other international agencies can help with the establishment of ILU's, for example, UNIDO has over the past decade organized:
 - the 1973 and 1976 expert group meetings on university-industry linkage;
 - the 1979-1980 national workshops on the same topic in Turkey, Malaysia and Indonesia;
 - the production in 1982 by a UNIDO consultant of a national plan for the establishment of ILU's in all five Malaysian universities.

- UNIDO assistance with the establishment of ILU's could take the following forms:
 - organization of national workshops to promote university-industry liaison;
 - provision of the services of consultants to advise on the setting up of ILU's;
 - staff development fellowships to enable potential ILU staff to gain experience in establishing ILU's.

- Enquiries regarding possible UNIDO assistance should be addressed to:

Chief,
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P.O. Box 300,
A-1400, Vienna,
AUSTRIA.

CHAPTER 2

OPPORTUNITIES AND OBJECTIVES

Change - economic, technological, political and social - is the outstanding characteristic of the modern world. This is true of both industrialized and developing countries, but adaptation to it is particularly important for the latter if the gap between richer and poorer countries is to be significantly narrowed. In developing countries, the potential for economic development is often great, but technical expertise and facilities are limited.

In this situation the universities occupy a key position. They are among the major repositories of both technical expertise and facilities. Unfortunately there is often a gap between the universities and industry which inhibits creative interaction. Developments in most industrialized countries and some developing ones have shown that the establishment of properly organized and adequately staffed industrial liaison units (ILU's) can do much to bridge the gap and promote collaboration to the benefit of both partners and to the society as a whole.

The fundamental problem to be faced is not one of organization but of attitudes. Too often industrialists regard academics as remote, theoretical and irrelevant to the real problems which industry faces. On the other hand, academics can be ignorant of, or even negative about, industry and be wary of involvement with it. Sometimes this attitude is reinforced by governments taking the view that university staff are there to teach and do research and that it is unethical for them to be involved with industry in profit making activities. Research policy can place too much emphasis upon the pursuit of knowledge for its own sake at the expense of socially useful applied research.

Few countries can afford to sustain such high handed attitudes, and certainly not developing ones. To neglect any opportunity of utilising expertise, wherever it is to be found, is to prejudice development and to waste valuable scarce resources. A Canadian study found that, of the problems that industry claimed it needed to have researched, no less than 80 per cent could be solved immediately by applying knowledge already acquired, leaving

only 20 per cent requiring further experimental work. So, although the universities in some developing countries may not have the facilities to undertake much costly fundamental research, there is much that they can do in applying the knowledge available to them through the international community of scholars to their own country's real, and often urgent, needs.

The philosophy lying behind university-industry liaison is simple. It is that the resources of facilities and expertise residing in the universities should be made available to assist the development of industry in its widest sense (including, for instance, agriculture and the service trades) for the good of the nation as a whole. Since those resources have almost certainly been made possible by the provision of public funds, this argument is eminently reasonable.

Moreover, the benefits do not merely flow in one direction. There is ample evidence that the involvement of academics in industrial liaison, for example, by consulting, improve the quality of their teaching and research. In turn this results in the production of university graduates who are more likely to be able to play an effective part in national development in all its varied aspects.

More specifically, the following benefits can accrue from properly organized university-industry collaboration:

(i) Industry gains by having:

- access to knowledge which, when applied, can enable appropriate technologies to be introduced;
- the stimulus of new ideas, leading to innovation and improved competitiveness in world markets;
- opportunity to buy time on expensive university equipment such as computers and testing machines;
- the availability of the consultancy services of academic staff, experts in their various fields of knowledge;
- access to graduate recruitment;
- some influence over university policy, resulting in improved graduate output.

(ii) Universities gain by having:

- the stimulus of relating theory to practice; important for staff development;
- the advice of industrialists in developing curricula, whilst preserving academic freedom;
- contract research;
- opportunities for industrial training and graduate placement;
- additional income from contract research, consultancy, royalties and patents;
- an improved image with government and society generally.

(iii) Individual academics gain by having:

- opportunities for consulting;
- means of keeping in touch with practice and thus making their teaching more effective;
- openings for research;
- facilities for personal development leading to improved promotion prospects;
- increased income and job satisfaction.

Provided the institutional arrangements for university-industry are adequate, these advantages to industry, universities and individuals are also of benefit to the nation as a whole in that it enjoys better use of its scarce resources of technical expertise and facilities.

There are, of course, problems as well as advantages, for example:

- the difficulty of striking the right balance between teaching and research on the one hand and consultancy on the other;
- the adverse effect of consulting on promotion prospects if universities do not consider it positively, but limit promotion criteria to the more traditional scholarly pursuits such as writing for learned journals;
- the question of how to allocate consultancy income between the university and the individual academic;
- problems of confidentiality and of ensuring that universities are protected against negligence, delay or incompetence on the part of their staffs undertaking consultancy or contract research;
- possibility of undue influence by industry upon academic policy.

In view of the potential advantages of university-industry collaboration and the problems associated with it, the formulation of policies, the clear statement of objectives and the development of appropriate institutional forms are of the utmost importance. Matters about which policies and objectives need to be established include the following:

- a clear statement that it is university policy positively to encourage interaction with industry;
- the institutional form through which that policy is to be formulated, be it simply a Liaison Officer, or an Industrial Liaison Unit, or a separate University Company;
- the activities to be promoted, e.g., research and development contracts, consulting, patents and licensing, testing, training, access to equipment, services to small business, etc.
- costing and pricing procedures;
- financing the service - fully self-financing or partly subsidised?
- allocation of income between the university's central funds, the relevant department, and the individual academic;
- the recognition of work with industry for promotion purposes;
- the permissible amount of time to be spent on work with industry, and whether there is to be any upper limit placed upon outside earnings;
- procedures for avoiding or reconciling conflicts of interests;
- ownership of property and other assets, including intellectual property;
- patent rights;
- equity participation in any spin-off companies.

In all this, however, it is essential to ensure that the important objective of promoting university-industry collaboration is subordinated to the even more fundamental objective of any university, namely the pursuit of learning, teaching and research. The clear statement of objectives will help to establish the right balance; sound management of the industrial liaison unit - the subject of the next two chapters in this guide - will help to keep it so.

CHAPTER 3

FUNCTIONS

The functions performed by industrial liaison units vary enormously, reflecting on the one hand the particular needs of industry and on the other, the expertise and facilities available in the universities. The need of industry and agriculture in one country are different from those in another. Then, too, not all universities have a full range of expertise from science to management studies. The two essentials are that needs to be identified and an inventory of available expertise and facilities be established.

Nevertheless, it may be helpful to set out the broad categories of functions that are performed by industrial liaison units in countries where they have been established. Not all will be relevant to every developing country but appropriate selections can be made in individual cases, and inventories of available expertise and facilities prepared. It is essential that universities decide frankly those areas in which they genuinely have expertise and not try to cover every topic. Nothing is more calculated to destroy credibility than for a university to fail to deliver the expertise that it has offered to industry.

There are four broad areas in which interaction between universities and industry typically takes place, namely (i) technology transfer, (ii) training, (iii) consultancy, and (iv) small business development.

These are considered briefly in the following paragraphs.

(i) Technology Transfer: Since one of the major functions of a university is to do research, there will from time to time emerge ideas, inventions and new developments which have the potential for conversion by industry into commercially viable products or services. Not all developing countries will be able to afford to do much fundamental research, but this should not deter them from interaction with industry. Indeed, a greater concentration upon applied research may well make the work of their universities even more acceptable to industry because it narrows the gap between research and development.

The task of converting the results of academic research into profitable business involves several stages of interaction between university and industry. The essential stages are research, development, prototype product, manufacture, marketing, and as these stages progress the role of the university diminishes and that of industry increases. Throughout, however, the role of the ILU is critical. It may well have been the first point of contact between the university and the company which is going to develop the product. An effective ILU director will make himself familiar with the potentially applicable research being done in his university, and will be constantly on the look-out for companies or government agencies which might be interested in its commercial development. He will then be the "marriage broker" who brings the two parties together.

Alternatively the research may not have arisen spontaneously within the university but may be the result of a research contract. In this case the role of the direction of the ILU is to act as the negotiator on behalf of the institution. Details of how he goes about this are considered in the next chapter; suffice it to state here that he will be concerned with costing and pricing the contract, allocating the resulting income, agreeing the time-scale, protecting the university's legal position, arranging for any patenting and licensing that may be involved and generally ensuring that the whole operation is conducted in a thoroughly business-like manner. This is where he can be of immense help to his academic colleagues who are likely to be unfamiliar with business practice and can be exploited or get into difficulty without the services which an ILU can provide.

Patenting and licensing, important as they are, are unlikely to loom large in the work of ILU's in most developing countries. Moreover, patents law is often complicated and the process of patenting requires highly specialized knowledge. There is usually little point, therefore, in having a patents expert on the staff of an ILU, but rather to use a well regarded external agency. Nevertheless, it is important for the ILU to be alert to patenting and licensing possibilities and to know where to go for expert advice. In a country with several universities, each with its ILU, there may be scope for centralising at a single point expertise in these highly specialized technical and legal matters.

To sum up, technology transfer through contract research can be of mutual value to university and industry. The former gains the advantage of externally funded research; the latter is enabled to investigate new areas of activity or develop new ideas at less cost than would be involved in installing the necessary equipment and expertise in its own organizations.

(ii) Training: As any economy develops there emerges an increasing need for training, both prior to entering employment and again at later stages in individuals' careers. Obviously one of the major and traditional functions of universities is to provide post-school, pre-employment education, often of a vocational nature. Although involvement in this aspect of the work of the university is not likely to be a major commitment of its ILU, nevertheless the unit can play an important role, by e.g., arranging industrial training opportunities for university students and involving them in industrial projects.

As the major interface between the two, it can transmit industrial needs to the university and, in the other direction, help industry to a better understanding of what it could gain from employing graduates. The two way flow of information through the ILU can improve curricula by making them more relevant to industrial needs and thereby increase employment opportunities for graduates. By greater involvement with industry, academic staff can improve the quality of their teaching and research which in turn will make graduates more employable. This intermediary role of the ILU is particularly important in the promotion of small businesses since they are less likely to be familiar with the opportunities and problems of employing graduates than the large companies which regularly recruit from universities.

An even more obvious role for the ILU is in the provision of post-experience training. As economies develop and technology changes, the need for up-dating or refresher courses increases and universities are a major source of the expertise needed to mount these. Doing so, however, is a professional and time-consuming business and it is economical for it to be handled centrally by the ILU rather than each university department mounting and marketing its own separate courses. This, too, is where the ILU can help departments by bringing to their notice training opportunities which it has identified through its continuing contact with industry. Courses may either be mounted in the university, or in a hotel, or in-house in the case of the

larger companies or state organizations. The ILU staff are, of course, not the teachers but the managers, relieving the academic staff of tasks for which they are likely to be ill prepared and would find uncongenial anyway.

(iii) Consultancy: A somewhat similar facilitating role is played by the ILU in arranging consultancies for academic staff whose expertise is in demand by industry or government agencies. This may be particularly important for smaller companies since they are less likely than the larger ones to know what skills are available among the university staff.

The advantages to the developing countries to be gained from encouraging academic staff to engage in industrial consultancy were considered in the previous chapter. There is, of course, a problem of making sure that individuals do not spend so much time on consulting that it is to the detriment of their teaching and research. In fact this is much less of a problem than is often feared, but, in any case, the ILU offers a solution to it. If the university rules that all consultancy contracts are arranged through the ILU, it can ensure that whatever limits are imposed on staff time spent in consulting are actually observed. Likewise, if there are restrictions on income from outside work, these can be maintained through the ILU; agreed scales of fees can be applied; insurance can be taken out against professional negligence, and the interests of all parties can be properly safeguarded. Ad hoc consultancies negotiated by individuals or departments involve the university in risks which it is better to avoid.

(iv) Small business development: Small businesses are particularly important in developing countries and yet they are the least likely to use university expertise and facilities on their own initiative. This is where the ILU can play the important role of matching university expertise to the particular needs of small companies. All three areas considered so far - technology transfer, training and consultancy - are relevant to small business development in the overall national interests.

In industrialized countries, universities have sometimes been directly involved in the creation of new companies, perhaps to manufacture and market a product based on an intervention deriving from academic research. This is not likely to be a common feature in developing countries. Indeed, as a general rule such universities would be well advised to stay away from the risks

involved in direct commercial exploitation of academic research. It is likely to be better to work with an experienced commercial organization which will shoulder the financial and commercial risks, perhaps with a licensing agreement providing for the payment of royalties to the university and the inventor. In such cases, the role of the ILU in negotiating and monitoring the arrangement is critical.

Science or industrial parks have become fashionable in industrialized countries and they might also be relevant in some developing country situations. Having a group of companies on or near a university campus makes interaction that much easier, but too much should not be expected of this type of arrangement which can bring its own problems if, for example, the land occupied by industry is later needed for university expansion.

(v) Other functions: Since the ILU is the focal point of contact between university and industry it is essential that it be seen as businesslike and professional in all its activities. It should develop and maintain a systematic data-base of company information, research projects, consultancy skills, training potential, etc. It should vigorously market the university to industry and commerce and needs therefore to be well informed and up to date. It should also be able to provide industrial contacts for academic staff needing research data, or for departments wanting to establish advisory committees or opportunities for student projects. If university equipment is not fully employed, the ILU may make time-sharing arrangements, for example, for materials testing by industry. Surplus capacity on university computers may be made available to small businesses which do not have their own hardware, software or expertise. Conferences may be arranged by ILU to bring industrialists and others into contact with the university and to provide a forum for productive discussion which may lead to future collaboration.

The essential function of the ILU is a marketing one, be it in technology transfer, training, consultancy or the other functions mentioned above. It will use every university - brochures, news letters, articles in the press, attendance at conferences, visits to companies, invitations to industrialists to visit the university, open days, trade fairs, and so on. The marketing function is not confined to external relations; the task of marketing industry to the ILU's own academic colleagues can be a formidable one, especially if

the university has become inward looking and remote, even perhaps hostile to industry. The next chapter considers how this tack can be tackled by the effective management of the ILU in the interest of all concerned.

CHAPTER 4

ORGANIZATION AND MANAGEMENT

(i) Organization: The forms of organization which have evolved for the promotion of university-industry collaboration are varied, ranging from the designation of an academic as industrial liaison officer to the separately incorporated university company with its own board of directors and full-time professional staff. It is unwise to generalize and to recommend one best way. What is certain is that there are two essentials. Firstly, that the university be fully committed to industrial liaison as a matter of policy and that this be stated as one of its objectives. Secondly, that, whatever form of organization is adopted, it should reflect the university's objectives, sub-culture, history, and local situation, rather than slavishly following some "ideal" pattern designed for a totally different set of circumstances.

The British experience, extending over more than sixty liaison offices has been summed up as follows: "Each university has chosen the methods best suited to its means and need of industry. In some cases the emphasis is on utilisation of the expertise and specialist resources, involving consultancies and sponsored work. In others, liaison with industry is encouraged to support the academic work of the engineering and science faculties. Whatever the means chosen - the Liaison Office, Industrial Liaison Unit, or University Company - each university represented seeks to improve the relationship with industry to the mutual advantage of both parties." (1)

A major decision is whether to establish the ILU as a part of the university structure or as a separate company. Each form has its own advantages and disadvantages. The former is more common and has the great advantage of simplicity, especially if, as is likely in developing countries, industrial liaison is a novel activity into which the university wishes to move with some caution. The internal ILU is in close touch with the academic departments upon whose expertise it has to draw, and it is less likely to get out of step with general university policy, for example in the matter of the allocation of overhead costs.

1/ Quotation from the introduction to the Directory of University/Industry Liaison Services, published by the University Directors Industrial Liaison (UOIL) Group and available, price 13 sterling from Brunel University, Uxbridge, Middlesex, England.

The separate company should be able to operate more commercially, being less inhibited by the university sub-culture and bureaucracy. It can pay its staff salaries based more on commercial practice and less on civil service scales and it can probably "hire and fire" more easily. Consequently it may be better able to behave entrepreneurially and be more market oriented than the international ILU. Moreover, the advantage of having limited liability may enable it to undertake somewhat more risky projects. In short, the separate company form of organization facilitates a more professional, business-like approach to organizations; the university has greater protection against mistakes and negligence by its staff engaged in consultancy, and industry may well prefer dealing with a body organized in a similar way to itself.

On the other hand, by the same token, there is greater likelihood of the university losing control of its liaison activities, and it may not get the benefit of the non-profit making public relations services that an internal ILU might be expected to provide on balance the internal ILU, managed as far as possible on commercial principles, is most likely to suit the needs of the majority of developing countries.

A second important policy question is whether to make compulsory the routing of all university-industry liaison activities through the ILU, or whether to allow staff and departments to make their own arrangements direct if they so wish. In the older universities it may be impossible or at any rate impracticable to do the former, since individuals and departments have long established direct relationships with industry and great resentment would be caused by forcing them to use the ILU against their will. Moreover, absence of compulsion means that the ILU has an added incentive to efficiency because it will only be used if staff and departments find it is advantageous to do so. The danger of bureaucracy slowing industry may ensue.

However, the compulsory system works well in some countries, including the United States, and may well be the best arrangement for developing countries to adopt. In these countries, where industrial liaison is less well established, governments and university authorities are often worried lest academic staff are seduced away from teaching and research by the pecuniary benefits to be derived from consulting. If all industrial liaison activities must be routed through the ILU, both government and university can be assured that there is proper control over the amount of time academic staff are spending on consultancy and how much income they are deriving from it. Such a

system also ensures greater consistency in the terms on which business is conducted, for example, in the matter of fees, allocation of overheads, and charges made for work done. There is less risk of the university becoming liable for mistakes or negligence on the part of its staff, or losing its proper status regarding the ownership of intellectual property.

Perhaps most important of all is that, by making the use of the ILU compulsory, the university is clearly stating its unqualified support for the units and its work. In the early stages of industrial liaison in a developing country this may well be of great strategy and psychological significance.

(ii) Staffing: Since so much of the effectiveness of any ILU depends upon personal relationships, both internal and external to the university, the selection and training of ILU staff is of great importance. At the top of the organization is a board of management or, in the case of a university company, a board of directors. This should contain both academic and industrial members, probably in roughly equal proportions. The presence of the University's chief executive (for example, the rector or vice-chancellor) on the board is a useful expression of its commitment to industrial liaison. It is a matter for local decision as to whether or not he or a prominent local industrialist should be chairman of the board. Having a businessman as chairman may make the ILU more credible to industry especially where there is suspicion that the university is unduly academic and theoretical. The board is responsible for framing, within the constraint of the university's overall objective, the policy within which the director and staff of the ILU are required to work.

The director of the ILU must be seen as its chief executive with full authority over his staff and the work of his unit. He should be a member of the board of management so that he can play an influential role in the formulation of policy. Since so large a part of the work of an ILU is communication both internally and externally the director needs to be an effective communicator, extrovert rather than introvert, and essentially a marketing man. If he has a scientific background and has himself been in industry, so much the better, since much of the ILU's work will be involved with science and technology. However, much more important is his marketing ability and, provided he is persona grata with scientists, he does not have to be one himself. He has to be senior enough to be acceptable with both

academic colleagues and senior businessmen, which means something like full professional status but not necessarily with that title. His relationship with the rector or vice-chancellor is particularly important for he will frequently require the backing of the chief executive, particularly in the early stages of his unit's life. To sum up, the director needs to be creative, entrepreneurial, innovative, a good communicator and decision maker, essentially the sort of person who can be the university's ambassador to the world of industry in both public and private sectors.^{1/}

The size and composition of the ILU's staff will vary from the small and simple to the large and complex. However, certain basic functions have to be performed and no one man can be expected to be an expert in all of them. There must, therefore, be adequate professional staff, with sufficient secretarial support to enable them efficiently to maintain communication with many contact points both within the University and outside. It is unrealistic to expect ILU staff to be experts in chemistry, physics, engineering and the rest, but they should be experts in liaison, essentially that is, in the business of selling know-how to industry. Marketing and social skills are therefore of the essence, but there must also be on the staff or available to them, those capable of making technical evaluations of proposals, and those with the legal and technical knowledge needed to negotiate contracts, licensing agreements and patenting arrangements.

Not all liaison work need require the involvement of the top people in the ILU. Some of the work is routine; much testing for example, falls into this category. There is, therefore, a need for junior staff to handle routine work and the senior people must be willing to delegate to them so as to avoid clogging the administration and causing delays which are unacceptable to industrial clients.

In fact, one of the major problems of managing industry-university liaison resides in the different timescales familiar to the two parties. Industry looks for quick results and delivery on the due date, whereas there is often a tendency for academic staff to extend the time required to complete a task, and not to regard delivery dates as being of first importance. The ILU has an important and often difficult task in getting academic staff accustomed to the tight time schedules demanded by industry.

^{1/} An example of a job specification for a Director of Industrial Liaison Services is reproduced as an appendix to this chapter.

Avoidance of bureaucratic delays is one reason, and economy is another, for not allowing ILU's to become over staffed. Only the minimum staff required to perform the necessary liaison functions should be allowed and as a general rule specialist services such as those of a patents expert should be brought in from outside agencies. In this way a lean and economical unit can be ensured, and many problems avoided.

(iii) Management: The efficient management of the ILU and its work is essential to success. Here the differing objectives and sub-cultures of university and industry must somehow be reconciled and this constitutes a daunting challenge for the ILU director and his staff. Where differences occur the business principle that "the customer is always right" must have supremacy, that is to say that the university must be prepared to work to industry's methods and time scales rather than the other way around.

This requirement reinforces the point made earlier about the importance of having the full and explicit backing of the chief executive of the university. From time to time his authority may have to be invoked in order to ensure that the university departments and staff accept the constraints of good business practice.

It follows from all this that the policies and procedures of the ILU are understood and agreed by not only the chief executive of the university but also the bursar and finance officer, the deans of faculties and, as far as possible, the academic staff as a whole. In an unfamiliar situation such as university-industry liaison, there is plenty of scope for misunderstanding, jealousy and ill-feeling, and it is important that everything possible be done to minimize this. What is essential is to establish beyond doubt that the ILU is not in competition with academic departments and their staffs, but is supportive of them and acting always in their interests.

Inevitably, one of the most sensitive areas in which misunderstanding and mistrust can arise is in the matter of finance. All financial procedures must be abundantly clear and conducted in a meticulously scrupulous manner, in full accord with the normal procedures of the university. This means that all monies received and paid are handled by the university finance office on the advice of the ILU rather than by the ILU itself. Regular financial reporting on a monthly basis is necessary, with the ILU presenting its annual accounts

and report to the university's finance committee for approval. Further points concerning finance are made in the next section of this chapter.

The essential managerial task for the ILU is, of course, that of communicating. This involves market research to discover what opportunities exist in industry for university expertise and facilities to be exploited. It also involves identifying that expertise within the university and matching it with the external opportunities. In the first instance both these tasks must be undertaken by the director of the ILU, although at a later stage, once credibility and good relations have been established, some delegation to other senior ILU staff may be both possible and desirable.

The internal search involves the director in visiting the departments and gaining the confidence of their senior staff. He must draw up an inventory of expertise and facilities and, most important, keep the data base up to date in a constantly changing situation.

The external task is, of course, even more extensive and evolving, since the whole of industry and commerce, in theory at least, offer potential for liaison. In practice, decisions have to be made about the extent and nature of the market to be tackled. The local area surrounding the university may be the most sensible place in which to start, even if subsequently more remote areas can be explored. Moreover, the university may well only have that expertise and those facilities which are relevant to a few particular industries rather than to all. It is a matter of identifying the target markets and exploiting them intensively rather than trying to do everything at once.

The social and marketing skills of the ILU director may well be needed even more when visiting industrialists than they are within his own university. For a time he will be an unknown quantity in industry, where managers tend to be somewhat secretive and suspicious of outsiders especially if they come from a para-statal organization or if, as in some developing countries, university staff are civil servants and therefore perceived as agents of the government. That initial suspicion must be overcome and the businessman persuaded that the university has something to offer which he should take seriously. This means that the ILU must not fall into the trap of offering what it cannot deliver; not only is credibility destroyed that way

but the university may be subject to legal action should it fail satisfactorily to complete a project and to do so on time.

A potential project may arise from the ILU staff's market research; or it may be the result of an individual academic's contact with industry; or once the ILU is well known, it may be on the initiative of an industrialist. In all cases, the ILU should explore it most carefully, including doing or having done on its behalf, a technical evaluation to ensure that it is feasible and within the capacity of the university to complete on time. Discussions between the ILU and the relevant academic staff must be full and frank and the lines of authority clearly established so that there is no doubt as to who is responsible for what, and when. The academic team and the client will be brought together by the ILU to agree the programme, the time scale, and the financial details, the latter having been carefully prepared beforehand by ILU staff, in consultation with the academics. Provided agreement is reached at this meeting a detailed written proposal will be prepared by the ILU, submitted to the client and, in due course a contract will be drawn up and signed by both parties. Until this has been done, work on the project should not begin. A pro forma for a project proposal is appended to this chapter, simply as an example of what has been found useful in an ILU recently established in a developing country.^{1/}

The commercial exploitation of research results, involving patents and licensing arrangements may not be as extensive in developing countries as in industrialized ones. Nevertheless, as development proceeds it becomes more important and management problems need to be anticipated. Universities should, therefore, establish procedures for all staff governing the commercial exploitation and patenting of research results. These procedures should set out the arrangements for the division of any income deriving from inventions, and should provide for the patent to be vested jointly in the university and the inventor. Likewise the conditions of employment of academic staff should specify the rules regarding consultancy in such matters as the proportion of time allowed on it, and the allocation of income from it. In all these potentially sensitive areas, the avoidance of misunderstandings by clear statements of policies and procedures is an important part of the management of industrial liaison.

^{1/} See appendix II, reproduced by courtesy of Prof. Francis Morsing, Coordinator of the Industrial Research and Consultancy Service, University Sains, Malaysia.

(iv) Finance: The major issue here is whether to require the ILU to be self-financing, or whether it should be subsidized. Certainly there is bound to be a developmental period in the early stages of liaison when the ILU cannot possibly finance itself. In general, however, the discipline of being required to become self-financing within a specified but reasonable period of time is a powerful incentive to enterprise and efficiency.

Nevertheless, it is important to bear in mind that some of the work of an ILU will not be, and can never be, income generating. For example, its public relations functions, publicising the university to industry and commerce is bound to be costly and only to generate income, if at all, indirectly and in the long run. Similarly, if the ILU is required to undertake work at less than full cost, perhaps for social reasons or because the government demands it, it should be subsidized for these activities which are not fully self-financing. This involves having an agreement between the ILU and the university administration as to the value of these public relations activities to the university, and crediting the accounts of the ILU with that amount annually, reviewing it from time to time as conditions change.

The importance of strict financial control cannot be over-emphasized. The traditional work of universities, teaching and research, has not led to the development of accounting procedures likely to result in accurate costing of projects undertaken. But accurate costing and commercial charging are essential for the efficient management of an ILU. The accurate costing of staff time and the proper allocation of overheads are important if the university is to avoid undercharging its clients and, in turn, being accused of unfair competition with other consulting organizations. This is particularly important since universities are usually public bodies, supported by public funds, and its commercial competitors resent public money being used to undercut them in the market place.

Overheads constitute a particularly difficult area and a firm, clear policy is essential. There should be a specified percentage overhead, of which part goes to the ILU as a contribution to its overhead, and part to the university and, where appropriate, the department concerned. In the matter of staff consultancies, there should be broad bands of fees, with reasonable flexibility, and a clear policy regarding the division of fee income between the consultant, his department, the ILU and the university. Charges should

fully cover all direct and indirect costs, including, for example computer time, and make an appropriate contribution to overheads. Included in the charge should be the cost of taking out professional negligence insurance, unless the ILU makes it clear that it acts only as agent for the consultant who in that case carries the liability himself.

The possibility for concealed subsidies and consequent loss in income to the university through under-charging are legion - failure fully to cost all salaries including administrative staff, buildings and services such as lighting and air conditioning, library and computing facilities, insurances, rates and taxes - all these are genuine costs which have to be met and should be covered in charges made to industry. Nevertheless, the overriding importance of effective marketing must not be allowed to be unduly constrained and a degree of marginal cost pricing with cross subsidisation from one project to another may be permissible, always provided that the total operation fully covers its costs and generates the appropriate surplus - the ultimate criteria of good management.

CHAPTER 5

NATIONAL AND INTERNATIONAL CO-OPERATION
AND THE ROLE OF UNIDO

The scope for national and international co-operation in the promotion of university-industry linkage through the establishment of ILU's must be considerable. The task is relatively new and demanding, whereas the resources and experience in developing countries are small.

Even in the industrialized countries, some government support has often been provided in order to help universities over the development stage. For example, in the United Kingdom, the University Grants Committee (the para-statal body which finances the British universities) decided in 1967 to set up a special fund to provide short-term "pump-priming" assistance to universities embarking upon approved schemes for the promotion of university-industry liaison. This financial support was limited to three years, by the end of which each scheme was to be either self-supporting or absorbed into the normal financing of the university concerned; if not, they were to be abandoned. Some sixty schemes were promoted between 1967 and 1974, of which 80 per cent were judged to have been wholly or partly successful. There are now over sixty liaison offices in British universities and their constituent colleges, most of which owe their beginnings to the UGC programme of development financing.

In Holland there are several government schemes to support industrial research and development, and linkages are promoted as part of the "innovation orientation programme". The government finances "transfer points" in the three technical universities; these are particularly directed at small- and medium-sized businesses, mainly in the locality of the universities concerned. Even in the United States of America state universities may receive financial support from the various states for the establishment of university-industry collaboration which is believed to be in the interests of the states' own industrial development programme.

If industrialized countries have found it necessary, or at any rate desirable, to provide financial support to universities embarking upon collaboration with industry, it is likely that the case for such action in

developing countries will be even stronger. Universities would, therefore, be justified in seeking government support for the establishment of ILU's on at least three bases, namely (i) the early developmental stage when earned income would be small; (ii) the provision of services to small companies unable to pay full cost fees; and (iii) the provision of services on a non-commercial basis as an aspect of the government's economic and social development policies.

In countries where there is more than one university, co-operation between them in the matter of their ILU's would be desirable. In Britain the University Directors of Industrial Liaison (UDIL) group exchanges information, shares experience and provides some common services. Where the number of universities is smaller, more common services should be possible. For example, specialized expertise in, say, patents, might be located in one ILU and supplied on an agreed financial basis to the others. The several universities might agree to specialize among themselves in what they offer to industry - one in engineering, perhaps; another in management, and so on. Or they might agree on a geographical division of the national market; or on a combination of the two approaches. Certainly if the government is providing finance for the establishment of ILU's, it is entitled to expect that they co-operate with each other to provide a better service rather than engaging in competition and wasteful duplication of facilities.

An example of such a national programme of co-operation is found in the People's Republic of China, where government policy not only strongly encourages university-industry liaison, but also provides a clear organizational structure for it. There is a large number of Ministries of Industry (for example, machine building, electronics, light industry, textiles, railways, etc.) and both research institutes and colleges up to university level are attached to these ministries. This means that co-operation between a particular industry and the relevant college or research institute is facilitated by the fact that they are all in the same industry and report to the same ministry.

In addition to this structural relationship, collaboration is promoted by establishing long-term agreements between universities and enterprises, these amounting virtually to joint ventures. Universities are also involved in surveys of natural resources and in the development planning of particular

areas, regions, provinces and municipalities. Co-operation between universities in a region sometimes results in the establishment of regional technological development centres, providing technical services to local industry. In addition, individual universities set up their own technical service organizations, sometimes as sub-centres of the regional organizations.

Within these various types of structure, the Chinese universities collaborate with industry in research and development, technical services, consultancy, exchange of technical information, training, and product development. It is accepted that such co-operation has benefitted all parties and the Chinese Government intends to continue to promote it as an important aspect of national development.

Turkey provides an example of a national programme for university-industry collaboration which combines centralization of administrative control with decentralization of operations. The national law relating to higher education stipulates that where necessary a central unit be established in universities to regulate relations between them and industry. These are known as "Turnover Accountancy and Management Units" and they regulate all the financial and administrative aspects of the projects carried out by a university in co-operation with industry. Project activities are, however, implemented by the individual university departments or the research centres that they have established. These research centres are not independent entities but represent the research capability of the parent academic departments. They are not allowed to recruit project personnel, but must use the academic staff of the departments. One of these staff members is appointed as Head of the research centre, which deals with projects paid for by industry as distinct from that academic research which forms part of the department's normal work.

Companies may apply either to the central unit or directly to the department/centre. In either case the technical part of the project idea is discussed between the applicant, the respective department/centre and a draft agreement is prepared covering scope of the work, implementation and budget. This is then transmitted to the Accountancy and Management Unit and a formal agreement is drawn up between the university and the applicant. Fifty per cent of the total fee is paid to the project personnel (academic staff) and the balance is kept by the Accountancy and Management Unit as the turnover capital.

In this way there is a national, centralized procedure for the administration, finance and control of liaison activities, whilst the conduct of the activities themselves is decentralized and left in the hands of the departments/centres, working within the national framework. This serves to combine adequate control with minimal bureaucratic constraints on liaison activities. These include applied research, design studies, consultancy, trouble shooting, feasibility studies, training, surveys, data processing and computer applications.

Another example of national planning and control of university-industry collaboration is to be found in the Syrian Arab Republic. In its desire to encourage the use of university resources, the Syrian Government decided some years ago that all government offices must give first option of consultancy contracts to universities. It also established procedures designed both to encourage academic staff to engage in liaison activities and to control possible abuses of the system. Under these procedures, 50 per cent of any consultancy fee go to the university, 40 per cent to the consulting staff, and 10 per cent to the liaison unit's general fund.

Several such units have been set up in the various universities, and one of them - at the University of Aleppo - had the benefit of UN support in 1978. This was the Integrated Industrial Consultancy Programme, designed, among other things, to link the University with international industrial and technological data bases; to implement a programme of computer assisted consultancy; to introduce an improved management and promotional system into the liaison service; and to train the university staff in liaison work.

The three cases described above - China, Turkey and Syria - exemplify the considerable scope that exists for national programmes of collaboration between universities and industry. International or regional co-operation is a good deal more difficult at the operational level, but the exchange of information and experience through conferences and workshops, and the provision of staff development fellowships by international agencies could be a valuable stimulus to the development of university-industry collaboration.

Indeed, UNIDO has already done a good deal along these lines and stands ready, within the resources available to it, to do more. In 1973, the Organization arranged an expert group meeting in Vienna on

"Industry-University Linkage with Special Reference to Management". This was followed three years later by a second expert group meeting on "Co-operation among Universities, Industrial Research Organizations and Industries and the Role of UNIDO in this Co-operation". These two meetings brought together senior people from both developing and industrialized countries who had had experience of establishing and managing linkages of various kinds between academic institutions and industry. The reports set out the advantages and limitations of the various forms of co-operation and included a number of case histories of successful liaison arrangements.

Considerable interest was aroused by these meetings and the reports of their deliberations and UNIDO decided to follow them up with a series of national workshops which would examine the problems of university-industry collaboration in local situations. This was an attempt to get away from generalized discussions to specific opportunities, difficulties and ways of resolving them in particular countries.

Three such workshops have been held so far; in Turkey in 1979 and in Malaysia and Indonesia in 1980. In each case, the importance of the role of ILU's was emphasized and recommendations were made regarding their establishment. Immediately following the Malaysia workshop in March 1980 the then Vice-Chancellor of the University of Sains Malaysia in Penang invited the UNIDO consultant who had been rapporteur at the meetings to visit his university to discuss with senior colleagues the possibility of setting up an ILU there. This was done and without delay a feasibility study was undertaken. It was found that several staff members were already providing services to industry although there was no formal machinery for doing so. A report, recommending the setting up of an ILU was accepted by the university senate in November 1980 and in May 1981 the Industrial Research and Consultancy Service was established. Thus, with commendable expedition, the University Sains Malaysia had, within little more than a year of the UNIDO initiative, formed a fully functioning ILU.

Not surprisingly, the success of the ILU at Penang led to interest being stimulated at the other four universities in Malaysia and the UNIDO consultant who had made the first contact at Penang was sent by UNIDO on a further mission to Malaysia to see if a national programme could be promoted. He had discussions with all five universities, the Ministry of Education and the

Prime Minister's Department, and reported favourably on the possibility of a national programme. UNIDO assistance for this is now being considered and interest in similar projects has been shown by other developing countries.

The possibilities for national and international co-operation are considerable and there is a much better prospect of UNIDO or UNDP assistance being forthcoming for a co-operative, national programme than for a project at a single university. Such assistance could take the form of the following:

- organization of national workshops to promote university-industry liaison;
- provision of the services of consultants to advise on the setting up of ILU's;
- staff development fellowships to enable potential ILU staff to gain experience in establishing ILU's.

Enquiries regarding possible UNIDO assistance should be addressed to:

Chief,
Non-governmental Organizations Section,
United Nations Industrial Development Organization,
P.O. Box 300,
A-1400, Vienna
AUSTRIA.

APPENDIX I

Sample Job Description for a Director of Industrial Liaison Unit

1. To develop and manage a University liaison service which while providing a central service for the negotiaton of contracts and making appropriate administrative arrangements, would also act entrepreneurially to locate and attract new opportunities for developing income generating relationships with national and international industrial, commercial and other sponsoring agencies.

Many Heads of Departments and members of Staff have, of course, existing and continuing good working relationships with many branches of industry and they would continue to use their own initiative in developing these and other contacts. The Director's services would continue to be available to assist in these negotiations, to draft contracts and to ensure proper pricing and financial arrangements, if requested.

2. In promoting activities which support the objective of increasing the flow of outside funds for research, the Director of Industrial Liaison Services will
 - (a) identify sources of expertise and special knowledge, etc., that exist and can be made available to meet the needs of the industry;
 - (b) develop an awareness and information on sources of funds such as the EEC research councils and other sponsoring organizations;
 - (c) establish a range of brochures and other publications in order to maintain and increase the level of awareness among potential users of university services;
 - (d) develop a wide range of contacts and channels of communication and co-operate with others to enhance the opportunities available;
 - (e) suggest new initiatives which might be developed;
 - (f) collaborate with the Local Authority, Chambers of Commerce, etc., in new initiatives such as discussion about a research or science park adjacent to the university.

3. Advise and act on behalf of the University on matters related to patents and licensing of University-produced materials including software and consultancy services.

4. Direct the activities of the University Company and its subsidiaries.

APPENDIX II

MODEL PROJECT PROPOSAL

While proposals will vary from a single page letter to a lengthy document with detailed technical discussion depending on the value of the project, certain elements will of necessity be always present. The following format is suggested as a guide in preparing the proposal.

- (i) **Background:** Defining the problem and putting it in perspective to the proposed project, particularly with regard to the client's interests and activities;
- (ii) **Objectives:** Summarising the purpose of the proposed activity and the objectives to be achieved;
- (iii) **Scope of work:** A very clear statement of the work to be accomplished on the contract is essential and must be related to the personnel and the amount of effort involved. Wherever possible, quantitative figures should be used (e.g., number of trips, number of samples, specifications, etc.). The principal investigator should never agree to modify this scope of work in any way during the performance of the contract without the prior knowledge and agreement of the ILU;
- (iv) **Personnel:** The principal investigator and any other professional personnel should be specified. If the Client's personnel play a role in the project, their identity and functions should also be specified;
- (v) **Facilities:** Any special equipment or installations required for the project should be detailed;
- (vi) **Client Participation:** If the client is to supply samples, materials, facilities or services, these should be enumerated;
- (vii) **Special Conditions:** Any conditions relating to patent rights, publications rights, advertising rights and liabilities should be included in the proposals. Other matters pertaining to contract termination, continuation, renewal or extension should also be included;
- (viii) **Schedule:** The schedule should indicate starting date, period to completion, significant milestones and dates for submission of progress and final reports;
- (ix) **Cost:** The total cost of the project should be given with the following items considered: use of equipment, consumables, insurance, labour, travel and living, other special costs and overheads. Invoicing and other procedures will also be specified, if the contract is a large one covering a period of time.

The Contract

This is essentially a "Memorandum of Understanding" with provision for the signature of the authorized officers of the client and the University. For small projects it could be the form of a quotation of a single page and for bigger contracts could cover a few pages. In all cases, it is the responsibility of the ILU to ensure that the contract terms are satisfactory.

Project Performance

The principal investigator will be responsible for all the technical aspects of the project, including performance to schedule and the writing of the report. The ILU liaises regularly with the principle investigator and provides him with timely reminders of other contract requirements. The ILU invoices the customer according to the agreement.

