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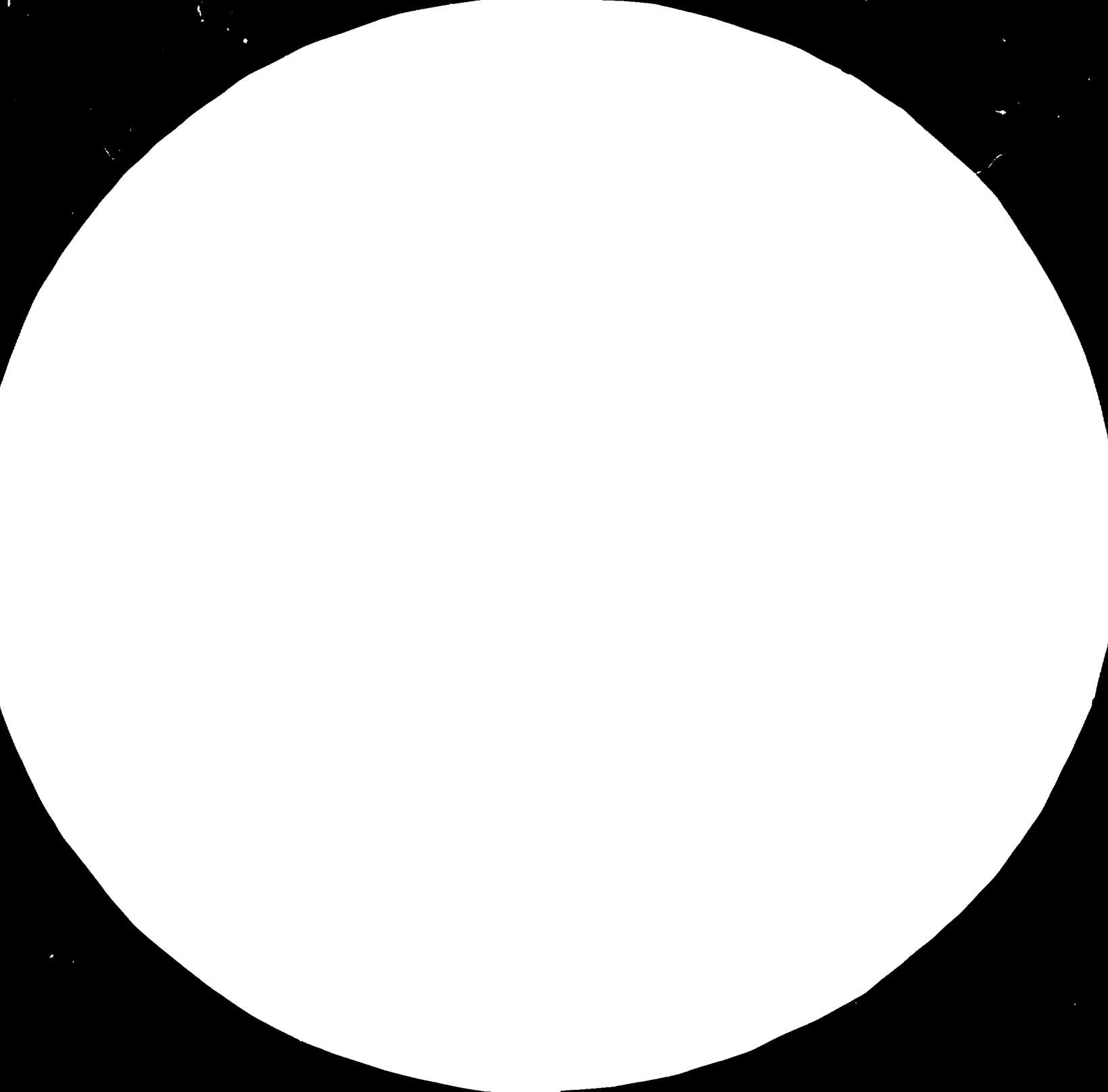

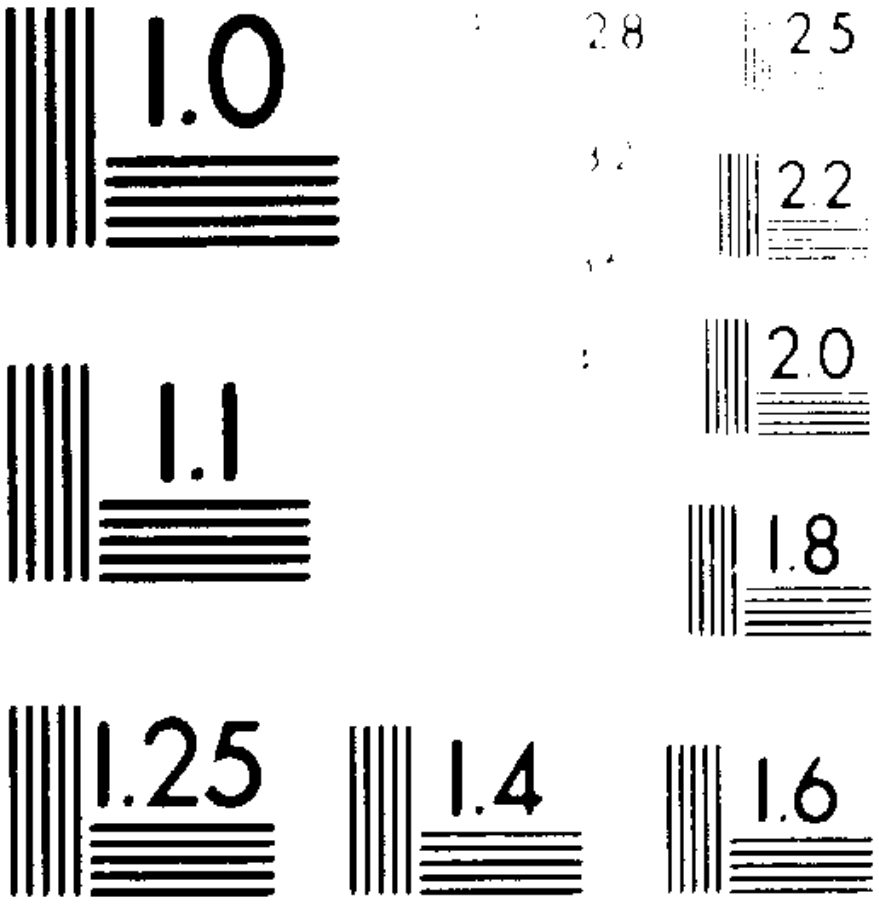

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

Joint AIDO/UNIDO Project
for development of the plastics processing industries
in Arab countries
UC/IDC/79/088

Study on establishment of a regional plastics development centre* for Arab countries.

by

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Prepared for the Arab Industrial Development Organization
by the United Nations Industrial Development Organisation

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* This report has not been cleared by the United Nations Development Organiztion and the views expressed are those of the author and they may not therefore represent the views of UNIDO.

ABBREVIATIONS

AIDO	Arab Industrial Development Organization
KISR	Kuwait Institute of Scientific Research
PIC	Petrochemical Industries Company (Kuwait)
KPC	Kuwait Petroleum Corporation
OAPEC	Organisation of Arab Petroleum Exporting Countries
SABIC	Saudi Arabian Basic Industries Company
SCH	Saudi Consulting House
SANCST	Saudi Arabian National Council for Science and Technology
SASO	Saudi Arabian Standards Organisation
FABCO	Abdulla Foaud and Abdulla Busbate Co Ltd. (Saudi Arabia)
ENPC	National Enterprise for Plastics and Rubber (Algeria)
IAP	Algerian Petroleum Institute
LDPE	Low density polyethylene
LLDPE	Linear low density polyethylene
HDPE	High density polyethylene
PP	Polypropylene
PVC	Polyvinylchloride
PS	Polystyrene
PU	Polyurethane
GRP	Glass reinforced plastic
FRP	Fibre reinforced plastics
R + D	Research and Development
RPDC (E)	Regional Plastics Development Centre (E) E = Easter area of region
RPDC (W)	Regional Plastics Development Centre (W) W = Western area of region

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A. SUMMARY

The nature of the Arab regional plastics industry is reviewed. Some five common constraints restricting the development and expansion of the industry are identified. These are dealt with under the following headings, isolation, training, quality control, marketing, research and development (R + D). The need of Government support to encourage the formation of Plastics Industry Associations to provide a common platform for the industry is discussed as a means of resolving the isolation of entrepreneurs and the material benefits that can be obtained are outlined.

Training is identified as the most urgent constraint facing the industry. The need for Governments to mobilize existing national resources to resolve some of this training requirement is discussed, and mechanisms for initiating action are outlined. A proposal to determine the feasability of developing mobile training units to meet the specialised needs for 'continuing training' which requires the training facilities to be close to the plastics factory areas is discussed. It is further indicated that these units could also be utilised for demonstartion purposes for technology transfer of processes, products and applications.

It is considered that the geographical spread of the Arab world justifies the establishment of two Centres, one to serve the eastern area (E) and the other to serve the western area (W) of the region. It is proposed that the centres should be called Regional Plastics Development Centre (E) and Regional Plastics Development Centre (W) respectively and developed separately as autonomous units within the umbrella of existing institutions. The main responsibility of the Eastern centre would be R and D with some training element while the main responsibility of the Western Centre would be training with some R and D element. It is proposed that RPDC (W) should be located at the Plastics Department of the Algerian Institute of Petroleum at Boumerdes, Algeria which already operates established training courses in plastics and has local accomodation available for trainees. It is proposed that a further

mission is necessary to finalize details and prepare a project document appropriately resolved by the activities of the Regional Plastics Development Centre (E), for which much enthusiasm and support was noted during the study. Several items of common-cause within the region were identified and are included in the proposed R + D activities for such a Centre. The possible location for the Centre is reduced to a choice of three institutions/organizations within the Eastern area of the region which are set out in order of preference. As it was not possible to finalize a choice of location and therefore to determine the actual host-institution facilities which could be made available to the Centre the remainder of the study sets out a detailed and carefully defined model-project for the establishment of Regional Plastics Development Centre (E) with an industrial orientation.

It covers both the developmental and immediate objectives, the background and justification, the structure of the Centre and the human, physical and financial resources required. Annexec C to G form an integral part of the project covering organisation chart, equipment list, consultant requirements, work plan, Bar-chart and job descriptions of key personnel. The project implementation covers the Institutional Framework, appointment of the Director of the Centre, a workplan and a list of activities. The outputs to be achieved by the project are detailed.

Such a centre would cost US $6,925,000 to establish over a four-year period and would employ 61 personnel. Mechanisms are also described to achieve both regional and international institutional linkages and co-operation to maximise benefits of existing resources. To secure co-operation and co-ordination between the two Regioanl Centre it is proposed that they both shall be controlled by the same Governing Board.

When the actual creation of the Centre (E) has been agreed and the facilities to be provided by the host institution have been identified the data provided in the model project is sufficiently detailed to enable a final project document to be prepared for the establishment of the Regional Plastics Development Centre (E).

Six recommendations are made:

B. RECOMMENDATIONS

The following recommendations are respectfully submitted to AIDO for their attention and actions as indicated.

It is strongly recommended that

1. AIDO should draw to the attention of appropriate Arab Governments or organisations the urgent need to encourage and foster the formation of Plastics Industry Trade Associations as a mechanism for developing an awareness in entrepreneurs and others of belonging to an industry. Additionally, it would also enable the fund of untapped knowledge within the industry to become more widely available thus solving some of the current constraints within the industry by self-help operations. Chambers of Commerce, or of Trade, could be used as the vehicles to promote the formation of such Trade Associations within their umbrella of activities.

2. AIDO should draw to the attention of appropriate Arab Governments or organisations that there is an urgent need of training required in the plastics industry (an industry distinct from the upstream petrochemical industry). The use of existing national resources and facilities within the countries, such as Universities and Vocational Training Centres should be activated for this purpose. As an initial step Professors from Universities and Training instructors from Vocational Training Centres should be encouraged to take the initiative and go out and make contact with the entrepreneurs and others at the various plastic factories in their country. By this means achieving a first hand experience of the industry, and developing an on-the-spot opportunity to discuss their training needs and problems. If Plastics Industry Trade Associations existed they could give direct assistance in this task.

In other developing countries qualified and experienced personnel from the plastics industry have volunteered their services to act as part-time professors or as training instructors at organised evening classes. This again is an activity which requires to be organized from a common platform such as a Plastics Industry Trade Association.

3. AIDO should draw the attention of appropriate Arab Governments or organisations that it is strongly recommended that two Regional Centres should be established. One would be known at the Regional Plastics Development Centre (E) covering the Eastern area and the other the Regional Plastics Development Centre (W) covering the Western area. Their functional activities have been outlined. Each would be developed as a separate autonomous Centre but with the same Governing Board in control of both Centres.

The Regional Plastics Development Centre (E) would cost US $6,925,000 to establish over a four year period and employ 61 personnel. Three possible sites for its location have been identified which have been placed in order of preference.

i. The Royal Scientific Society at Amman, Jordan

ii. The General Organisation for Petroleum and Chemicals at Basrah, Iraq

iii. The Plastics Centre within the Petrochemical Institute which it is proposed will be established by the Saudi Arabian National Committee for Science and Technology (SANCST) at Riyadh, Saudi Arabia

The Regional Plastics Development Centre (W) should be established at the Plastics Department of the Algerian Institute of Petroleum at Boumerdes, Algeria. This has on-going training courses and facilities in plastics, and also has local accomodation facilities for students.

4. AIDO should request the services of a UNIDO consultant for a one month mission to Algeria for technical and administrative discussions with appropriate Government Ministries and Departments to obtain the necessary

information to prepare and complete a project document for the Establishment of the Regional Plastics Development Centre (W) at Boumerdes, Algeria, and the financial input required.

5. AIDO should draw the attention of appropriate Arab Governments or organisations and in particular in Algeria and Iraq, where physical resources for mould-making are installed, the need to develop long term plans for the training of very specialised craftsman in mould design and mould-making (including extrusion dies) for the plastics industry.

   The mould-design and mould-making industry is a very important auxillary industry on which the longterm success and development of the Arab plastics industry will depend.

6. AIDO should undertake a feasability study to determine the cost and the technical requirements to develop mobile training units required for undertaking 'continuing training' operations which require the training facilities to be located within easy access of plastics factories.

   These units could also be utilised for demonstrations and technology transfer of adapted or new processes, products or applications thus serving the needs of both Regional Centres.

C INTRODUCTION

This mission was undertaken under the umbrella of the AIDO/UNIDO project for Development of the plastics processing industries in Arab countries.

The main objective of the mission was to prepare a project document (prodoc) for "The establishment of a regional plastics development Centre" The document would also:

(a) specify the range of activities to be undertaken which would also include a training provision
(b) set out a mechanism for liason and co-operation with existing institutions or organisations working in this area
(c) specify and quantify the human, physical and financial resources necessary to establish the Centre.

The consultant arrived in Bagdad on 13 January 1985 and left on 5 March 1985. During this period project travel was also undertaken to Algeria, Kuwait, and Saudi Arabia to obtain information essential for development of background and justification for the project. Unfortunately due to visa problems it was not possible to visit Libya as had been originally planned.

D MISSIONFINDINGS

1. The nature of the plastics processing industry

In most developing countries the structure of the plastics processing industry tends to follow a basic pattern. The industry generally consists of a few large companies, with 500 or more employees, representing between 2-5% of the total number of companies. This is followed by the medium sized companies with 100-500 employees representing about 10-15% of the total number of companies. These two groups produce between 50-60% of the total plastics output. The last group is the small-scale companies with less than 100 employees, generally with less than 50 employees in fact. This small-scale group is important for the future growth of the industry. Experience shows that while it can be expected that some 25% will drop out of the industry over a period of time on the other hand about 15-20% will eventually reach the medium-sized company level. Within this latter group it will be found that most of the entrepreneurs are technically qualified persons who bring the necessary drive and initiative to introduce new technologies into the industry. In addition they have an understanding of the need to produce consistent quality articles at competitive prices.

Based on the information received during this mission and from other reports the structure of the plastics processing industry in Arab countries follows very much the above pattern.

The large companies as a whole tend to be equipped with their own laboratory and testing facilities as well as employing plastics-engineers or plastics technologists and technicians. This position is achieved through the availability of more in depth management skills within such companies and the larger financial turn-over involved. In some cases the technology has been purchased and the quality control system comes as part of the package.

Among the medium-sized companies only a few will have any laboratory or testing facilities and perhaps only one or two technically qualified plastics-engineers/technologists. In the small-scale companies it is unusual to find testing facilities although some basic elements of quality control operate such as product dimensions.

In any programme to support and strengthen the industry it will be observed that the greatest need lies within the small-scale companies.

2. Problems facing the industry

The visits and discussions undertaken in Algeria, Iraq, Kuwait and Saudi Arabia have been very informative, constructive and open. The general inpression has been formed that the plastics processing industry is like a small child within anxious parents (Governments). It is trying to run before it can walk. The development levels achieved by the industry are in themselves complex but, when viewed as a whole, there are a number of common constraints which can and will limit both the future expansions and progressive development of the industry.

These constraints can be covered under the following general headings:

(a) Isolation
(b) Training
(c) Quality Control
(d) Marketing
(e) Research and Development

(a) Isolation

Most public and private sector companies appear to be operating their factories in total isolation both from the rest of the industry and from all the peripheral supporting facilities that currently exist. This is not an unusual phenomenon. It is one of the stages that most plastics processing industries reach during the course of their industrial development.

There are currently no plastics trade associations, although it has been noted that in Saudi Arabia the first steps to form a Plastics-pipe manufacturers Association have been taken. This is a positive and encouraging sign. In many countries it is the Chambers of Commerce or Chambers of Trade who initiate such activity by establishing a special section within their organisation for this purpose. Thus by using the administrative umbrella of the Chamber of Commerce the financial costs associated with running an Industry Association are substantially reduced, and at the same time it provides the plastics processors with opportunities to meet and talk with a wide range of business contacts. It also greatly assists the process of confidence building a necessary cornerstone in the successful development of any industry. The provision of this common platform for meeting and discussion of mutual interests also enables the individuals concerned to develop the experience of belonging to an industry. A process which takes a long time to achieve and is currently a missing ingredient in the Arab plastics processing industry.

In addition a trade association, with suitable guidance, can assist in the identification of constraints within its industry that restrict its growth and expansion. Moreover it can generally develop self-help schemes to resolve some of these common constraints by utilising the very large knowledge base that exists within the industry but currently remains untapped.

It is therefore extremely desirable that appropriate actions should be taken by governments to foster and encourage the formation of Plastics Trade Associations as one of the mechanisms of developing an industry identity.

It is therefore strongly recommended that AIDO should draw to the attention of appropriate Arab Governments or organisations the urgent need to encourage and foster the formation of Plastics Industry Trade Associations as a mechanism for developing an awareness in entrepreneurs and others of belonging to an industry. Additionally, it would also enable the fund of untapped knowledge within the industry to become more widely available thus solving some of the current constraints within the industry by self-help operations. Chambers of Commerce, or of Trade, could be used as the vehicles to promote the formation of such Trade Associations within their umbrella of activities.

(b) Training

In many cases factory owners are depending on the skills of imported labour for the processing technology, but it has to be fully recognised that in many cases these skills are either of poor quality or out-dated for the many very modern and up to date machines with which the Arab countries have equipped themselves. This is high-lighted by the high proportion of machinery breakdowns and the equipment damaged. In the atmosphere of a seller's market the entrepreneur or the Government as owner can afford to be generous and could turn a blind eye to such problems since the profit margins achieved are still very generous. However, when it is financially necessary to become competitive such as when the seller's market changes to a buyer's market the facotry owner has basically three options to choose. One, he can continue as before and absorb the inevitable losses which will result from such a decision. Two, he can sell-up and leave the industry and make his investment elsewhere, or three he can identify and resolve the constraints within the company. In the small-scale sector there will most probably be a need to provide technical support to assist in the identification of these constraints.

The basic training requirement appears to be at the level of process technician, higher technican and maintenance technican to overcome some of the current problems. In majority of cases this involves training of imported labour. The type of training required is known as 'continuing training' which is basically up-dating training and can be achieved in

relatively short period of time. However, it has to be pointed out that in the small scale sector in particularly it is generally not possible to free a person from his work for more than one day at a time, yet alone one week which would normally be regarded as minimal. The reason for this difficulty is due to the fact that small scale entrepreneurs are unable financially to afford to carry excess of surplus personnel. Therefore, the absence of one person would generally mean the output of the factory would be reduced. Likewise it is not normally possible to take a machine out of production to use it for training purposes for the same basic reason.

Based on information received it would appear that there is a communications gap between the plastics processing industry and the training/educational establishments in most Arab countries. This seems to be greatest within the small-scale entrepreneurs, but it also includes some medium-sizes companies. Universities are the 'ivory towers' that appear to the non-graduate as impenetrable, while vocation training centres are 'run by people who do not know my needs'. Similar problems have been experienced inother developing countries and it is not therefore unique to the Arab world.

There are various ways in which this gap can be closed. The professor of polymer science or of engineering can take the initiative and make a point of visiting some of the local plastics factories to meet the staff and to see what processes etc. are in operation, and also assess their need of trained technical staff. He can discuss the areas of common interest and the research work of the University in the field of plastics (if any). He can invite the staff to visit the University to meet his collegues and to see for themselves the type of facilities they possess. In some circumstances this can be initiated by an 'Open-day' at the Department concurred.

In a similar manner the chief instructor of the appropriate section of the vocational training centre can take the initiative to make a series of factory visits, and also organise invitations for factory staff to visit the training centre.

Experience has shown that for this system to work effectively it is necessary that the initiateive is taken by the educational/training establishments particularly in relation to small scale units. As a result of such initiative, in some countries, the technically qualified staff of the factory undertake part-time evening work as professors, instructors in plastics technology in the teaching institutions. This makes maximum use of the scarce resource of qualified and experienced technologists in plastics.

From the foregoing it will be observed that it is possible to close this communication gap and there are potential benefits to be derived by both sides. However, there still remains the problem of how to start this process. In the case of the Arab countries AIDO could draw the attention of governments to this problem and advise that the Ministries concerned should request the appropriate institutions to start such an initiative, and to institute any follow-up action that may be required.

It is therefore strongly recommended that AIDO should draw to the attention of appropriate Arab Governments or organisations that there is an urgent need of training required in the plastics industry (an industry distinct from the upstream petrochemical industry). The use of existing national resources and facilities within their countries, such as Universities and Vocational Training Centres should be activated for this purpose. As an initial step Professors from Universities and Training instructors from Vocational Training Centres should be encouraged to take the initiative and go out and make contact with the entrepreneurs and others at the various plastics facotries in their country. By this means achieving a first hand experience of the industry, and developing an on the spot opportunity to discuss their training needs and problems. If Plastics Industry Trade Associations existed they could give direct assistance in this task.

In other developing countries qualified and experienced personnel from the plastics industry have volunteered their services to act as part-time professors or as training instructors at organised evening classes. This again is an activity which requires to be organised from a common platform such as a Plastics Industry Trade Association.

Where plastics trade associations are established they can also request Government for similar assistance, and being an Association are in an excellent position to arrange the visits in an orderly and organised manner. In fact, one of the important functions of such a trade Association is to identify constraints in communication and to formulate mechanisms for overcoming them.

A special problem arises in some Arab countries. Such training which is now required will involve the training of imported labour. Strong views have been expressed on this subject which in general are against the training of imported labour. This is based on the belief that such labour is already trained. It does not acknowledge the need for 'continuing training'. While a seller's market exists and large profits can be made it is possible to absorb the high costs of replacement spare parts that result from the high level of machine-breakdowns and the consequent low level of productivity. However, the day will arrive when the market changes to a buyer's market. In these circumstances the entrepreneurs or Government organisations will be seeking to improve productivity in order to maintain profits. Training will then be seen to be a necessity for a company to succeed in the plastics business, but it will be rather late to take action then since training takes time. Those who have the foresight and a vision of the future will be pressing now for training programmes to be implemented.

In addition to the immediate need of 'continuing training' there is also the need of regular training of nationals as technicans, superior technicans in processing and maintenance, and of technologists such as plastics engineers, and post-graduate specialised engineers in plastics. Until a nucleus of such trained personnel has been built up it will not be possible for the nationals of their own country to start to take-over the manning of their plastics industry. It is perhaps necessary to stress that this process is a long one and there are no known ways of compressing this learning cycle.

The facilities for training in plastics technology in the Arab countries are very limited, with the exception of Algeria. Most Universities and other institutions include some reference to polymers or polymer science

in their courses, but there is no detailed study of plastics technology. However, it is necessary to highlight the plastics training facilities that are available at the Algerian Institute of Petroleum (IAP) at Boumerdes located some 40 km from Algiers. Here they have developed 2 year courses for plastics technicians, 3 year courses for higher technicians as well as post graduate training for a Masters Degree in plastics. The language for this training is English. A number of students have been trained from neighbouring countries through bi-lateral agreements, and this aspect of the programme can be expanded.

The centre does not currently undertake 'continuing-training' but it has identified the requirement. Additionally, it has realised the necessity of taking this type of training to the factory area. For this purpose it has been proposed that a group of pre-fabricated buildings should be erected, in a suitable area, in each of the five towns in which most of the Algerian plastics industry is located. All the prefabs would be suitably converted to act as classrooms, and to accomodate various types of plastics processing equipment on which training would be undertaken. Maintenance would also form an essential part of this type of training. It has been proposed that there should be a central core subject area to build up the necessary theoretical background and add on to it areas of specialisation. Staff required for the training would come to each location for specified periods from IAP. Thus in this proposal the training staff would be the mobile element. Unfortunately although the proposal was made some time ago no action has yet been taken to implement this idea.

Training in plastics technology is a subject area which could be well accomodated on a regional basis, and could therefore fit as one of the activities of a regional R + D centre. The mechanism of operation envisaged is that personnel engaged in normal developmental activities of of the Centre become experienced plastics technologists. A limited number of them with the necessary aptitudes, would be able to act as trainers and could be allocated for that purpose. In addition, the regional centre, being the focal point of knowledge of the regional plastics industry, would be in an excellent position to assess both current and future training requirements of the industry.

As a regional operation there would have to be a new approach developed to tackle the problem of 'continuing training'. For this type of training to be successful there is without doubt a positive need to take the training to the vicinity of the plastics factories. The method proposed in Algeria is excellent in its concept but will be highcost since it involves much duplication both of accomodation and of equipment. If cost is not an important consideration then this method could be utilised throughout the region.

An alternative system would be to make the total operation mobile. Such a concept is new and would require a certain amount of development work to determine its practical feasability. It is visualised that this mobility could be achieved by using road transporters fitted with large adapted shipping containers. The containers would be suitably modified to act as a class-room, as a maintenance workshop and as plastics processing shops fitted with equipment for extrusion, injection and blow moulding etc. These units could then be sited at a given location for a predetermined period and then moved to the next location. They could also be taken from country to country.

Obviously there are a number of factors that would have to be considered so that the operation could be successfully undertaken, but the technology and loggistics of moving such types of units is well known and should not therefore be a major difficulty. An initial development project to prove the practical feasability of this mobile training concept could consist of the development of one road transport unit fitted with an extrusion line or an injection moulding machine. If this were successfully achieved the development could then be extended to cover the other required units.

The necessary staff to undertake the training would be provided by the Regional Centre, and supplemented by staff from national institutions who may wish to extend their range of training to include plastics technology. It is envisaged that the mobile units would be in one location for about a one month period before being moved to their next location. By using three teams of training instuctors on a rota basis, this would ensure the individual instructor is away from his base only one month in three .

This will provide each instructor with the opportunity of continuing with his development work at the Regional Centre and thus keep in active association with the developing technology.

There are of course other variations of this method which could be adapted depending on the requirements of the Centre and the policy of the Director, but the above has been given only as an example to indicate that the staffing requirement for mobile training is a practical proposition. This human factor is a very important one and requires constant monitoring to ensure its successful operation.

(c) Quality control

In Arab countries it would appear, in general, that plastics processing, with the exception of some of the larger organisations, consists only of purchasing raw materials, processing it into plastics products and selling the products. This is the way the industry started. However, plastics processing is a much more complex business. Entrepreneurs and Government-owned units have yet to learn that plastics in a very dynamic business, the technology is in a state of constant development and that the end-user is the most important person in the business. Products supplied for industrial or agricultural applications have to possess certain basic performance characteristics and it is these performance characteristics that the purchaser is really buying. If the plastics product has not been processed correctly the defective article, while visually identical with a perfect product, can give premature performance failure in use with consequential losses to the user.

To date there have been relatively few published national specifications for plastics products in the Arab world; and in consequence there has been little pressure on the majority of processors to pay the necessary attention to product quality and the development of internal product specifications. This situation has progressively evolved since it has been a sellers market, Additionally, effective product quality competition from imports has been negligible due to the level of protective import duties. However, with the

rate of demand currently falling the situation is showing the first glimpse of change. When the industry finds it needs to be competitive to obtain business there will be a need to provide centralised technical assistance to improve and maintain quality through introduction of quality control techniques.

Such assistance will need to be provided on a national basis as it will involve regular supervisory visits. However, the main constraint at the present time is a shortage of trained and experienced plastics engineers/ technologists to undertake such work, as well as the wide range of test equipment that will be required. Whilst equipment can be purchased in a relatively short time and placed in an appropriate national institution the training of the specialised personnel is a longer commitment, and this could be a suitable area for a Regional training activity.

(d) Marketing

So far as can be ascertained there has been little use made of marketing as a business tool for the plastics processing industry and this is not suprising when it is realised that, at the present, there exists a seller's market for plastics products. However, this situation will inevitably change. Moreover, if the industry is to expand it will require marketing services to develop further the existing outlets as well as to identify and develop new markets. Effective marketing requires skilled and experienced personnel and there is a shortage of such manpower in the Arab countries. In those countries with centrally planned economies marketing is a word associated with free-enterprise systems; yet such countries use some of the basic elements of marketing since they examine the user needs and based on internal priorities, plan to produce the correct product for the user at a given period of time.

There is a need for marketing services in plastics processing industry in the Arab world, and in view of the limited trained and experienced manpower available in this area it is a service that could be provided from a Regional Centre. It is an activity therefore that should be fitted into the general concept of a Regional R + D centre which would strengthen and support the expansion of the industry.

(e) Research and Development (R + D)

The plastics industry is a dynamic and growing industry. It is extremely versitile and serves the requirements of a wide range of users in the home, in industry and in agriculture. A large proportion of this success and diversification of end-uses has been due to the active and professional supportive role played by R + D. To ensure the future growth of the industry this work needs to operate on a continuing basis.

It is to be noted that in the Arab world there are only three countries that have established or plan to establish a centralised facility to provide R + D support on a continuing basis to strengthen their national plastics industries. The idea of a specialised R + D Centre to support a specific industry appears to be a relatively new concept in some Arab countries but it does permit focusing of skills and resources not achievable in a wider-based industrial research organisation. Successfully operated it does enable the industry to achieve positive growth.

In the Arab countries, in general, there are very limited R + D facilities available and specialized experienced manpower necessary for such activities is extremely scarce. Some pilot plant facilities are available in some teaching institutions and at raw material (polymer) suppliers. Similarly, such organisations have a selection of testing equipment for plastics as also do some of the national standard organisations. All operate in their own limited sphere. The need to avoid duplication of programmes in general industrial research and to maximise the benefits of scarce and skilled man-power within parts of the Arab world appears to have been recognised. The first elements of co-operation in Industrial Research, not specifically in plastics, have been demonstrated by the initiation of annual regional meetings of Research Directors of various Institutions. One common problem to which attention is currently being paid, which has a potential plastics element in it, is to find an alternative economic sack for cement as a replacement for paper sacks which have to be imported.

The need to develop a continous R + D effort to support the plastics processing industry has already been recognised in Saudi Arabia, in Algeria and in Egypt. In Saudi Arabia a plan is being formulated to develop a

science/technology city to act as a bridge between the University and Industry. One of the units to be included will be an Institute of Petrochemicals within which will also be included an R + D Centre for Plastics as well as Centres for Synthetic Textiles and for Synthetic Rubber.

The time-scale for this development has not yet been finalized.

Within the SABIC organisation in Saudi Arabia it was reported that there are well equipped laboratories including a range of pilot plant which is utilised to provide marketing services to their polymer customers. Also at the University of Petroleum at Dharhran there is stated to be a range of pilot plant for plastics which is used in their training operations.

In Algeria, following a policy change in October 1984, there has been established within the Ministry of Energy and Petrochemicals a Co-ordination committee to maximise the use of trained personnel and equipment in specialised groups within the country. The first priority has been Petrochemicals as representing the area of greatest need, and plastics is a part of that operation. This has involved identification of facilities available and the development of co-ordinated research programmes. This is presently in its early stage of development but represents a very positive step to provide a continuous R + D programme to support and strengthen the plastics industry on a national basis. Pilot plantand testing equipment for plastics has been located at various institutions which will be utilised for these R + D programmes.

Plastics R + D work is also being undertaken in other Arab countries of which the following are some examples:

In Kuwait at the Kuwait Institute for Scientific Research (KISR) plastics is a relatively small section within the Petroleum, Petrochemicals and Materials Division. It is reasonably well equipped with a range of high quality laboratory and testing equipment but lacks pilot plant equipment. It undertakes sponsored research and has done some limited work on plastics. Judging from the 1982 research reports it orients more towards the University than it does to industry. It is primarily a Research institution, as its name indicates, a point which was confirmed in subsequent conversations .

In 1982 a proposal to establish a rubber and plastics development Centre in Kuwait was scheduled for Government consideration. Enquiries made during the visit to Kuwait revealed no active knowledge of this project nor was it possible in the time available to visit the Ministry of Commerce and Industry to obtain first hand information. However, the existence of such a proposal does indicate an active interest in this area, which was confirmed during the visits.

In Egypt, in Alexandria, there is a Plastics Development Centre which was started in 1980 with UNIDO assistance. It has staff of about 120 persons covering a wide range of activities including testing, pilot-plant processing development, application development, trouble shooting, and information services. It is currently engaged in developing a plastics in agriculture experimental/demonstration station as part of the application development work in extending the market area for the use of plastics through increasing agricultural productivity and produce quality. It has undertaken some limited training operations and is currently oriented to the Africa region.

In Jordan, in Amman, at the Royal Scientific Society there is a plastics section within the Department of Engineering. It is equipped with a selected range of plastics testing equipment, and it also has a injection moulding machine for process development work. It provides technical support to the plastics processing industry and operates on a limited scale.

In Iraq within the Organisation for Petroleum and Chemicals at Basra it is reported that there is a well equipped laboratory with testing equipment and pilot plant to support the polymer manufacturing activities. Also at Basra there is located a Petrochemical Training School which runs 2 and 3 year courses for technicians and higher technicians aimed at the requirements of the petrochemical industry, but it does not include plastics. Some 600 trainees are admitted to the courses each year and they provide living accomodation facilities for them. There is a further training centre in Bagdad which covers training for the oil industry but it does not have living accomodation facilities. Training to date has been limited to Iraqi nationals.

It is generally recognised that there is a need to support and strengthen the plastics processing industry through a continuing R + D activity, and this view was clearly identified during the series of visits undertaken. The idea of establishing a Regional R + D centre (an Arab Centre) to undertake programmes: of common national interst, and to support the general development of the plastics processing industry was received with positive enthusiasm. Discussions on the potential activities which it ought to undertake covered a wide area and these have been listed below:

3. List of activities for a regional R + D Centre

1. Joint R + D co-ordinated programmes
2. Increased productivity by
   (a) inprovement in process technology
   (b) poduct improvement and development
3. Market studies and analysis
4. Application-development and demonstrations
5. Technical support and development of Regional Standards, codes and specifications
6. Regional testing and analytical facilities
7. Regional technical and market information services
8. Liaison activities with
   (a) regional plastics industry
   (b) raw material producers and machinery manufacturers
   (c) Arab governments and institutions in the region
   (d) international technical organisations
9. Promotion of the Centre's activities
10. Training, up-grading and the creation of skills

4. Mould design and mould making

Little reference has been made in previous reports to the importance of mould design and mould making in relation to the plastics industry. All the moulds currently used appear to be imported. Since the majority of plastics processes require a mould or die to form the actual

plastics product being manufactured it will be evident that mould-design and mould-making is a very important auxillary industry for the plastics industry.

It has to be stressed that mould-desingers and mould-makers are extremely skilled people at the top of the profession. Mould-making is primarily an engineering industry operation, and specifically it represents a very specialised area of tool-making which is a craft trade. It is estimated that it takes five to eight years to train a mould-maker.

In Algeria there is a plastics mould making factory at Setif but it is understood that it is not really operational mainly through lack of trained personnel. In Iraq a tool and mould organisation was started only in late 1984 primarily to produce moulds and tools for the car trade. It is intended that it should also produce moulds for plastics.

Thus, it will be observed that while some mould and die manufacturing facilities have now been introduced into the Arab world the main key element of trained personnel is still missing.This is a subject which will warrant much careful attention for future action.

When a Regional R + D Centre is established this is an area in which it will need to have close collaboration as the technology of plastics has a direct relationship with mould design and mould making.

5. The nature of the regional R + D centre concept

The concept of a single regional R + D centre for plastics to serve the whole of the Arab world is excellent in theory. When the practical implications are considered it is a different matter. The very large and widespread geographical distribution of the Arab world immediately high lights the long lines of its communications and the problems these impose on frequent travel. In addition an examination of the detail shows there are differing orientations with neighbouring states arising from geographical positions. On this basis there appears to be a natural division

into two areas. The Western area covering all those Arab countries lying in the North African region, and the remainder forming what can be called the Eastern area.

In terms of a regional centre it would be more practical and pragmatic to think of this as two centres, one to serve each area. The development of two centres brings with it a further set of problems. They could be developed as two completely separate units but this could produce difficult problems of co-ordination. They could be developed on the basis that one is a satellite of the other which is the main unit. This could bring a different set of problems not least being the human one of personnel promotion in such a situation.

Consideration of these problems in a different manner produces a more acceptable solution. The functions of the regional R + D Centre essentially break down into two items, namely, research and development on the one hand, and training associated operations on the other hand. Thus, it becomes feasible to consider one centre having responsibility for R + D with some training element while the other centre has responsibility for training with some R + D elements. Bearing in mind the need for very close co-operation and co-ordination between the two centres, even though the central functions have been divided, it is considered more appropriate in order to achieve a successful operation that both centres should be developed as separate autonomous units. However, to ensure that the necessary co-operation and co-ordination is effected it is proposed that the same Governing Board should have control of both Centres.

To further develop the theme of unity it would be more appropriate to remove the specific functional activity from the title of the Centre. It is therefore proposed that the Centres should be called either Regional Plastics Development Centre or Regional Plastics Technology Centres. For the purpose of this study the former title will be utilised. The Eastern or Western area of the region will be indicated by inclusion of (E) or (W) after the title. When a decision to proceed with the establishment of such Centres has been made further attention to titles could then be given if so required.

Thus there would be:

A Regional Plastics Development Centre (E) RPDC - E
and a Regional Plastics Development Centre (W) RPDC - W

6. Location of the centres

Experience indicates that the chances of success for a project are much higher if a new institution can be established within or under the general umbrella of an existing on-going institution/organisation. It is this principle which has been followed in determining the location for the centres.

(a) Regional Plastics Development Centre (W)

Bearing in mind the current activities that have been identified within the region in relation to training it becomes self-evident that the Regional Plastics Development Centre (W) should be established within the Plastics Department of the Algerian Institute of Petroleum (IAP) at Boumerdes in Algeria.

(b) Regional Plastics Development Centre (E)

It has proved to be a very difficult task to determine one suitable location which can be recommended for establishing the Regional Plastics Development Centre (E). The choice has been narrowed down to three locations which are set out in priority order.

1. Within the umbrella of the Royal Scientific Society (RSS) in Amman, Jordan.

This country has no petrochemical industry, but it has specialised in the development of high-level manpower. The RSS has experience in orienting its work to industrial requirements and has a plastics section which has undertaken such programmes. It has an established infrastructure which has been built-up over a period of time.

Telephone, telex and postal communications are excellent. There are generally no visa problems nor restrictions on travel.

2. Within the umbrella of the Organisation of Petroleum and Chemicals at Basra, Iraq

The laboratory facilities, although not examined, are reported to be extensive and include much pilot-plant equipment. It has an established infrastructure.

Telex communication is excellent, internal telephone can be slow, but international service is excellent. Overseas postal communications are extremely slow. Visas are required to be obtained before arrival and exit visas are necessary. There can be restrictions on travel. Some of these difficulties are probably due to the war . In any case the facilities at Basra could not be used until peace has been re-established. Internal and international flights are excellent.

3. Within the umbrella of the Plastics Centre at the Petrochemical Institute to be established in Riyadh, Saudi Arabia

This would be a totally new complex and is presently only in the 'idea' stage. The alternative consideration of placing it within the SABIC facilities has been considered, but it is feared that the commercial considerations involved would at some time produce a conflict of interests, and for this reason this alternative has been rejected.

Telex communication is excellent. Internal telephone can sometimes be difficult due to overloaded lines, though it is understood this is being rectified. International telephone service is excellent. There can be difficult problems in obtaining visas and processing visas can sometimes take many days. The dress requirement for females could severely restrict the flow of trained female personnel and experts.

Internal and international flights are excellent.

It is strongly recommended therefore that AIDO should draw the attention of appropriate Arab Governments or organisations that two Regional Centres should be established. One would be known as the Regional Plastics Development Centre (E) covering the eastern area, and the other the Regional Plastics Development Centre (W), covering the western area. The functional activities have been outlined. Each would be developed as a separate autonomous Centre but with the same Governing Board in control of both Centres.

The Regional Plastics Development Centre (E) would cost US $6,825,000 to establish over a four year period and employ 61 personnel. Three possible sites for its location have been identified which have been placed in order of preference.

i. The Royal Scientific Society at Amman, Jordan
ii. The General Organisation for Petroleum and Chemicals at Basrah, Iraq
iii. The Plastics Centre within the Petrochemical Institute which it is proposed will be established by SANCST at Riyadh, Saudi Arabia

The Regional Plastics Development Centre (W) should be established at the Plastics Department of IAP at Boumerdes, Algeria. This has on-going training courses and facilities in plastics, and also has local accomodation for students.

7. Model for the Establishment of a Regional Plastics Development Centre (E)

In order to deal with this subject in an effective manner it is proposed to detail the outlines of a model Regional Plastics Development Centre (E). This information could then form the backbone of any project document which would need to be prepared once a decision in principle has been taken to proceed and the actual location for the Centre has been confirmed. Such a project document would need to take account of both buildings and laboratory and any other facilities that would be made available to the project by the host organisation.

8. Outline of objectives

(a) Development Objectives

The implementation of this project will assist in achieving the following long range objectives:

1. to maximise the Arab productive use of both the current and proposed polymer capacity within the Arab world, amounting to more than 2 million tons for the improvement of the regional economy.
2. Support and strengthen the development of the Arab plastics industry
3. Create new employment opportunities

(b) Immediate Objectives

The immediate objective of this project is to establish an operationally active and effective Regional Plastics Development Centre (E) - RPDC (E) - to undertake and provide both technical co-operation and support necessary for strengthening and expanding the Arab plastics industry.

The Centre will be controlled by a Governing Board, responsible for the over all policy and plan of the RPDC (E), executed through the Director of the Centre. The RPDC (E) will enable the Arab plastics industry make a positive contribution to both rural (including agricultural) and industrial development, through the co-ordination of its activities with other Arab national institutions and or organisations in the development of appropriate applications of plastics and to increase outputs and productivity in those areas. This will be achieved by the RPDC (E) ensuring that the outputs of its operations are made known to both the co-operating institutions and organisations as well as to the ultimate users utilising appropriate communication mechanisms and systems for this purpose.

9. Background and Justification

The amount of plastics processed in Arab countries in 1980 was 789,000 tons. This figure was forecast to increase to some 1,103,900 tons in 1985 and current available information indicates this to be of the correct order of magnitude. It includes polyethylene, polypropylene, polystyrene, polyvinylchloride, polyurethane, unsaturated polyesters, polyamides, polyacrylates and thermosetting plastics.

There are however a number of problems encountered throughout the region by the arab plastics industry in their efforts to achieve an orderly, efficient and rapid expansion. Shortage of trained personnel, use of imported labour, lack of quality control and standards, good mould design and mould making trained personnel, knowledge of the requirements of plastics products for the consumers and sufficient experience in application development are some of the immediate problems.

Although plans are in hand to establish national specialised R + D Centres for the plastics industry in Saudi Arabia and in Algeria there is as yet no centrally directed effort in the other Arab countries to maximise the benefits of existing facilities that could be utilised to serve the needs of their national plastics industries.

The Arab countries, in particular, Algeria, Iraq, Kuwait, Libyan Arab Jamahiriya, Qatar and Saudi Arabia allhave large petrochemical complexes which are currently operating or plan to produce in total the following: 1,256,000 tons LDPE/LLDPE, 426,000 tons HDPE, 50,000 tons PP, 305,000 tons PVC and 15,000 tons melamine-resin.

With the rapid growth of the plastics industry a communication system must be built up between the raw material producers, the equipment manufacturers, the plastics processors, the plastics trade, and the consumers to ensure that efforts are directed into the most beneficial channels for all.

With the massive increase in availability of polymer supply there will be an urgent need to identify and develop new market areas and expand existing ones, to increase the processing capacity of the industry and to maximize the production of existing processors if the added-value benefits to be derived from increased polymer availability are to be fully exploited.

The establishment of a Regional Plastics Development Centre (E) which will be industrially oriented, will play a key role in these activities. It will be established and equipped to provide regional technical support to the Arab plastics industry and to narrow the gap between the raw material producers, the plastics processors and the end-users. It will promote and activate the development of national R + D services for the plastics industry. It will identify programmes of common interest to the Arab region and undertake the necessary applied research and development to support the regional plastics industry.

The Centre should have close ties with other arab institutional and organisational bodies which are actively operating in the field of plastics such as KISR in Kuwait, for example. This can be most conveniently arranged by inviting a representative of such organisations to sit on the Governing Board of the Centre or on special liaison committees thus promoting the possible development of Arab sister-institutional arrangements By this means close technical linkages can be developed through which joint co-operative programmes can be undertaken to mutual benefit or by

sub-contract arrangements, if necessary.

In addition the Centre should develop close ties with international institutions and organisations operating in the field of plastics and should establish at least one sister-institutional arrangement. By this means the Centre can ensure that it becomes fully aware of the technology developments at the frontiers of knowledge, to which, in the course of time, it will be able to make its own contribution.

The Centre will also provide on-the-job training in the Centre for selected individuals from the regional plastics industry in developing experience in processing technology and material testing. Technical seminars will be conducted periodically on new processing technology for the regional plastics processors and users.

The Centre will also liaise, co-operate and co-ordinate closely with its other half the Regional Plastics Development (W) for plastics and will provide services or facilities which may be required.

In entering new market areas where product preformance becomes the main criteria, there will be a need to manufacture to standards and to utilise quality control. For a large number of plastics processors this will be a new experience and this will require the technical back-up services of national development Centres for plastics. The Regional Centre contribution will be directed to the technical preparation and development of Regional standards and testing proceedures involved. It will aslo provide and offer specialised testing services as and when these may be required..

The Centre will assist and support the regional plastics industry to successfully meet these challenges in market identification and development, applied technology development and transfers, and assisting in the creation of new employment opportunities through increasing process capacity.

The Centre will be developed to have the expertise and resources so that it can identify market areas, undertake application development programmes necessary to exploit these new and existing market areas,

process and product development work necessary for supporting these application development programmes, together with appropriate back-up services, of communications (library, technical information, technical services, external liaision etc.) and a science-based investigational facility with co-operation through Universities or specialised Institutions.

In addition the communications service will be developed to assist in the promotion of increasing the regional processing production capacity of the industry and the in-plant training of the Centre's personnel. By these means it will be possible to up-date the plastics processing technology, improve product quality and productivity, assist the regional industry to enter new market areas and expand existing markets, and create new employment opportunities within the Arab region.

The use of plastics in building and construction, inpackaging and in agriculture are the three priority areas that have already been identified as requiring a regional approach in their development.

In the building and construction applications plastics are used as pipe and fittings for water supply and storage, and as pipe covering. The use of foamed plastics as insulation material is gaining interest due to the conservation of energy which its use achieves. With other competitive mineral foams becoming available this is an area which will warrant some investigative work. With wood in short supply, particularly in the Eastern area, there is a requirement to examine wood-product substitution. Plastics window frames, shutters and doors are products that need to be developed to satisfactorily withstand the extreme environmental conditions in the region.

The types of plastics products used for packaging needs to be identified and appropriate regional specificaitons developed. The competition of imported products should be countered through the development of improved and economic technologies of production. New opportunities for plastics packaging should be identified throughout the region. Close co-operation with the Institute of Packaging in Morocco should be developed for this applicaiton area of plastics.

The use of plastics in agricultural applications as a means of improving product quality and agricultural outputs has been developed to varying degrees within the Arab region. There are still anumber of applications to be developed not least is the use of plastics film as a mulch (a covering of the soil). This not only assists in retaining the moisture in the soil but it also prevents weed growth when the film is optically black and thus permits the soil nutriments to be available only to the growing plant. Increased outputs within the range of 20-300% have been achieved depending on local conditions and type of corp grown. Other applications include water conservation with reservoir and pond lining, irrigation canal lining, channel lining, trickle irrigation (also known as drip irrigation) as well as tunnel covering, greenhouse covering, planting bags, plant pots, soil isolation, etc. There are many known solutions to agricultural problems utilising plastics which are covered under the following areas of applications:

1. Growing
2. Disease and pest control
3. Water conservation, supply and drainage
4. Fertilizer transport, storage and application
5. Crop conservation
6. Livestock raising
7. Produce collecting, transportation and storage
8. Tools, machinery and equipment
9. Buildings and construction

In this context it should be pointed out that the work "agriculture" is taken in its widest meaning to include all things which grow, and related areas. It therefore includes:

1. Agriculture
2. Horticulture
3. Forestry
4. Produce handlings, storage and pre-packing
5. Water management
6. Fisheries, etc.

The Centre should establish contact with and become member of the International Committee for Plastics in Agriculture in Paris to develop an awareness of activities in this field, as well as promoting the development of contacts with Ministries of Agriculture, Committees and other institutions operating or interested in this area.

The disfigurement of the environment by plastics scrap is a matter of greater concern. The recovery of such scrap through traditional methods is not always successful. The Centre should investigate, develop and adapt new technologies for handling this scrap and ensure the knowledge is widely disseminated.

The need for a strong auxillary industry in both mould and die design and manufacturing is a key factor in the long-term development of the plastics industry. However, such an acitivity falls more naturally into engineering tool design and manufacutre as a very specialised area of that industry. There are currently two factories in the region equipped for mould making one in Iraq and one in Algeria both of which currently lack experienced and trained personnel. Contacts should be established with both these factories to enable technical/technology interchanges to take place on a continuing basis.

10. Structure of the Centre

The structure of the Centre is designed to effectively serve the needs of the Regional Plastics Industry.

The activities to be undertaken by the Centre, on a continuous basis, to support the development of the regional plastics industry are as follows:

1. Processing and application development
2. Market and Technical information services
3. Testing and investigational services
4. Regional standards and test proceedures

5. Regional and international co-operation and liaison
6. Engineering services
7. Training (internal)

These facilities will be executed through sections, linked through divisions and headed by the Director of the Centre. A basic organisation chart is set out in Annex C.

(a) Governing Board

The Centre will operate as an autonomous body administered by a governing board which shall have full authority to establish the policy guidelines, approve the annual programme, budget and salary scales.

Any government or financial institution within the Arab region contributing financially to the establishment and operation of the Centre shall be entitled to be represented on the Board. Such a Board member should be nominated by the Government from its appropriate Ministry holding responsibility for the plastics industry.

Other related institutions and organisations covering both public and private enterprise should be invited to participate as Board members.

The Director of the Centre shall be an ex-officio member of the Board.

It is suggested that before the formation of the Board there should be established a "Standing Committee" consisting of not more than five persons including one who can be regarded as an "Uncle" to the Centre. He will possess a deep conviction of the need for the Regional Centre committed to the development of an active and prosperous plastics industry and will have a wide range of high level contacts. Ideally, he should be the chairman of the Standing Committee, which becomes the nucleus of the Board, and would therefore become its first chairman.

(b) Host organisation

It is necessary that there should be a strong linkage with the host organisation under whose umbrella the Centre will be established. There are several possible mechanisms but these would need detailed discussions with the parties involved to arrive at a mutually acceptable and beneficial arrangement. The following are given by way of example only.

The chairman, or president, whoever is the figurehead of the host organisation could be invited to be the figurehead of the Governing Board. In addition, the Director of the host organisation should be a member of the Governing Board of the Regional Centre, and the Director of the Centre could be made an ex-officio member of the Board of the host organisation thus forming a double linkage at Director level.

(e) Director of the Centre

The director of the centre is the key element in determining the success of the project. Great care is therefore required not only to identify the right person but to ensure that the financial package and inducements are of a satisfacotry nature to secure his tenure of office for some years.

He should be a highly qualified plastics technologist with a wide range of experience in the plastics industry. The Director must have managerial and planning experience and be a skilled administrator. Ideally he should also have experience in modern techniques relating to the control of finance, human and physical resources. He must be a self-motivated person with a pleasing personality and possess the capability of exerting the driving force necessary for the successful establishment and operation of the Centre.

To find all these attributes in one person is extremely rare. Therefor. an alternative consideration would be to have a highly skilled technologist with a driving force personality as the Director and have administration skills left in the hands of a Deputy Director. In any case both persons would need to work closely together to form an inter-

linked team, thus giving the example to the remainder of the Centre staff of "team-spirit"which it is necessary to promote and foster.

(d) Organisational Structure

In order to meet the operational requirements of the Centre the organisation is divided into two Divisions and eight sections. One Division deals essentially with the various types of services to be provided by the Centre while the other Division handles the technology aspects.

An essential feature in establishing a Regional Centre is to maintain a high degree of flexibility and pragmatism in the approach. Because of the dynamic nature of the industry the type of assistance and support required from the Centre must be expected to change with time. If the Governing Board and the Director of the Centre feel a different organisational structure would serve the requirements more effectively then there should be no hesitation to introduce such changes.

The actual structure set out in Annex C is a model based on past experience. However, it should be remembered that in working with the host organisation it may be possible to marry some of the functions with those already existing within the host organisation - an amalgam of facilities. For example, several of the administrative and engineering functions could be most easily absorbed. It is this type of detail that has to be discussed with any potential host organisation. From the host organisation they may be prepared for their existing plastics technology facilities to be absorbed by the Centre on the understanding that the staff concerned and their work-load can be accomodated within the operational programmes of the Centre.

By this means the Centre can be closely integrated with the host organisation yet still retain its regional autonomy.

(e) Technology Division

This Division includes three Sections, namely:

i Investigations and testing

ii Process technology

iii Application development

In developing the principle of flexibility it is highly desirable that each of the section-leaders are given an opportunity to control each Section within the Division over a period of time. This develops a broader experience and ensures continuity of work during periods of unavoidable absence.

The sections, by their nature, will need to employ a number of differing disciplines and this will enable multi-disciplined teams to be formed to undertake specific programmes.

The Investigation and Testing Section will be concerned with the following areas of activity:

1. Co-operation with national government organisations and institutions in the technical areas involved in establishing data on which standards can be based, and where necessary, development of test methods.
2. Acting as a reference point for checking and testing performance of products
3. Acting as a reference point for checking effectiveness of testing equipment
4. Undertaking investigational work for the other Sections, or for clients, involving sophisticated equipment or techniques and developing a wide range of specialised experience.
5. Development of personal contacts with local Universities and appropriate Research Institutions.

The Process Technology Section will be concerned with the following areas of activity.

1. Producing prototypes for evaluation
2. Evaluation of raw materials
3. Development of new or adapted processes and products
4. Demonstrating process techniques and training selected personnel
5. Solving industrial problems

The Application Development Section will be concerned with the following areas of activity.

1. Field performance-testing of new or adapted plastics products
2. Establishing correct application proceedures for maximised performance
3. Solving field-application problems

Some of the fields of activities are detailed in the organisation chart but there are in fact many more. Plastics, correctly designed and applied can solve problems in a wide range of industries and in agriculture It is in this last area - agriculture- that is of great importance to developing countries and of special interest to least-developed countries (LDC's). This is perhaps one area that deserves to be given special attention by the Regional Centre.

(f) Technical Services Division

This Division comprises three sections, Engineering, Information Services and Communication Services. It provides services to other sections of the Centre as well as providing the direct link with other national institutes and organisational and the regional plastics industry which it serves.

The Engineering Section will be concerned with provision of:

1. Maintenance, repairs and modification work
2. Running and maintenance of utilities
3. Design, drawing and fabrication of specialised items. If it is necessary that larger items are sub-contracted it will be responsible for supervising the sub-contract work.

4. Running the workshops (machines, instruments etc.)

This section, at a later stage, will develop close technical contacts with the mould design and mould-making facilities in the Region. It will also be expected to be able to produce some limited moulds for use in the Centre and to develop expertise in this field. In addition, in association with the plastics technologists of the Centre it will develop a technical knowledge of the limitations of current processing equipment and of the developments in the market of new process equipment. By this means experience will be developed in the engineering aspects of plastics processing machinery.

The Information Service Section will be concerned with

1. The acquisition of technical data
2. Assessment of technical information
3. Providing market studies, through market research and assessment
4. Providing technical information and data, and an industrial enquiry service to governmental and private clients.
5. Publication of a Regional Plastics Technical Journal

This section will require to progressively build-up a specialised library, and to develop access to current plastics technical-data information banks through appropriate subscription. The work will be assisted by the development of appropriate statistical records and computerised storage and selection operations. The section will also be responsible for filing any patents that may arise from the programmes undertaken by the Centre as well as contracts for services with sister-institutions etc. The Centre will also possess or have access to translation services to enable it to undertake its programmes. The publication of a Regional plastics journal will also be developed.

The Communication Service Section will be concerned with

1. providing personal technical contact with all regional plastics organisations, and when necessary with the regional plastics industry as well as with appropriate international organisations.
2. providing contact with the public media for the dissemination of information

3. producing films, videos, posters etc. to support the other activities of the section
5. organising and providing the necessary transportation requirements of the Centre

The external liaison undertaken by this section is a key activity in the operation of the Centre since it is the mechanism by means of which the activities and work of the Centre are fed back to the prime user, namely, the regional plastics industry. It provides the means by which the regional plastics industry can become aware of new technolgies and for technology transfer. It is a two-way system of communication since it feeds back into the Centre information on problems which the industry faces and the regional aspects of those problems can be determined. Through its international liaison it can make the Centre aware of the "current state of the art". Attendance and participation at overseas conferences and exhibitions is an essential element in keeping in touch with the advancing technology.

It is intended that the long term aim of the Centre should be to develop as a "Centre of excellence" and its public activities and presentation of technology papers arising from its work programmes will be one area by which its achievements can be measured.

(g) Training Section

As it is intended that there should be established a second Centre, a Regional Plastics Development Centre (W) having very close co-operation with this Centre, the main training activity of the RPDC (E) will be directed at internal-staff training. However, at a later stage, as the Centre develops the opportunities will arise for the placement of graduates undertaking a Masters course in Plastics to undertake part or all of their project activities within the Centre programmes. Such placements will be made by agreement through the Regional Plastics Development Centre (W).

To ensure the necessary co-operation and liaison is exercised the Training Section has been made a direct responsibility of the Deputy-Director.

The training of internal staff is an important matter if the Centre is to achieve its objectives. Local training of internal staff in factories within the region, is an essential element if the industry problems are to be fully appreciated. Overseas training also forms an essential part of the training programme for Centre staff. For such training to be effective it has to be organised and suitably programmed. During the initial stages, in the formation of the Centre, training will be concentrated on key personnel consisting of Director, Deputy Director and the two Division leaders. Overseas training should have high priority as a first activity of these personnel.

The training programmes will include the following:

Familarisation study tour (for the Director)
Study tours
Overseas fellowship training
on-the-job training
team training

Sister institutional (twin-ing) agreements with an overseas institute can play an active part for training in advanced technology and techniques Such arrangements ought to include a two-way interchange of staff.

Past experience indicates that once the Centre is operational a staff turn over of the order of 25% should be expected. This will be due to 'poaching' of trained and experienced personnel by the regional plastics industry. For the industry as a whole this is an excellent progression since it places the technical skills at the point of production, and the advantage of training is not lost. However, it does mean that the personnel section of the Centre must be constantly seeking potential employees and the internal training programme will need to constantly remain active.

(h) Administrative Section

This covers the general broad requirements of services which can well be headed by an accountant with wide administrative experience. It is possible that most of the work of this section can be absorbed into the general administration of the host institution although additional staff

will be required. However, the Director of the Centre may wish to retain direct control of the administrative head of the section as the finance and budget will be quite separate items from that of the host institution. Linkage mechanisms will require detailed discussions.

11. Inputs required

(a) Human Resources

i. Personnel

The personnel requirement is divided into regional staff and servicing personnel. Table I 'Personnel requirement for the Centre' sets out the requirements on a year by year basis (Year 1, year 2, year 3) over which the numbers will be built up as the Centre develops.

During the construction period of the building of the Centre temporary office accomodation would be required for a limited number of personnel. It is estimated that 12-18 months should be allowed for the completion of the building. The build-up of personnel over the first four year would be as follows:

	1st year	2nd year	3rd year	4th year
Number of persons	11	36	61	61

The full compliment of personnel being reached in the third year at 61.

The first year of the project starts with the identification and recruitment of the Director of the Centre. All prior activities to this recruitment are regarded as preparative. The recruitment of the chief technologists, the information officer, the marketing officer, the engineer, need to be accomplished soon after the appointment of the Direcor so that various preparatory work can be undertaken including finalisation of equipment specificaitons, and ordering. Also during this period there will be developed a period of training in factories in the region as well as study tours overseas. The Director will undertake, as a matter of urgency, a familiarisation study tour to Europe to selected centres to become aquainted with the problems of establishing similar type institutions, if required he can be accompanied by an international consultant to provide on the spot guidance in relation to the Regional Centre (E). Immediately upon his return he will be able to consult with the architect to finalise the building requirements of the Centre. The recruitment of the Deputy Director and administrative offer will be required for the second half of the 1st year.

PERSONNEL REQUIREMENTS FOR THE CENTRE

TABLE I

A Assignment of Regional Staff	Year 1		Year 2		Year 3		Year 4	
	m/m	US $	m/m	US $	m/m	US $	m/m	US $
(1) Director	12	46,460	12	46,460	12	46,460	12	46,460
(1) Deputy Director	6	21,120	12	42,240	12	42,240	12	42,240
(2) Chief Technologists	24	71,800	24	71,800	24	71,800	24	71,800
(3) Technologists	-	-	36	50,700	36	50,700	36	50,700
(4) Assistant Technologists	-	-	24	25,340	48	50,680	48	50,680
(4) Technicians	-	-	24	21,120	48	42,240	48	42,240
(1) Technical information Officer	12	16,900	12	16,900	12	16,900	12	16,900
(1) Librarian	-	-	6	8,450	12	16,900	12	16,900
(1) Assistant Librarian	-	-	-	-	12	12,670	12	12,670
(1) Marketing Officer	12	16,900	12	16,900	24	33,800	24	33,800
(1) Administration Officer	6	8,450	12	16,900	12	16,900	12	16,900
(4) Administrative Assistants	6	6,335	24	25,340	48	50,680	48	50,680
(1) Engineer	12	25,340	12	25,340	12	25,340	12	25,340
Total	90	213,305	210	367,490	312	477,310	312	477,310
B Provision of servicing personnel	m/m	US $	m/m	US $	m/m	US $	m/m	US $
(6) Process workers	-	-	36	31,680	72	63,360	72	63,360
(6) Application workers	-	-	24	16,900	72	50,700	72	50,700
(4) Unskilled labour	-	-	24	12,680	48	25,360	48	25,360
(4) Craftsmen (maintenance)	-	-	24	25,340	48	50,680	48	50,680
(5) Secretaries/typists	12	6,340	36	19,020	60	31,700	60	31,700
(2) Clerks	-	-	24	12,680	48	25,360	48	25,360
(2) Storekeepers	3	1,585	18	9,510	24	12,680	24	12,680
(4) Guards	6	8,450	36	12,690	48	16,920	18	16,920
Drivers	6	2,115	24	8,460	36	12,690	36	12,690
Total	39	18,490	222	148,960	420	289,450	420	289,450
Total (A + B)	-	231,795	-	516,450	-	776,760	-	776,760

GRAND TOTAL: 2,301,765 US Dollars

Note: m/m = man months

The above data is based on 1982 Kuwait salary information updated by 10% to allow for general increases.

The second half of the second year should be taken up by installation of equipment, some of which may not be completed until the first half of the third year. Nevertheless, by using existing facilities within the region some work programmes could be started in the second year. The real commencement of work programmes in the Centre would not start until the beginning of the third year.

Since the Centre will be a regional one it is assumed that it will be staffed by various arab national personnel within the region. This is an item that requires clarification at an early stage. Also whether the Centre will be restricted by national quota allocations of personnel, or whether it will have a totally free hand to employ the most competent personnel available.

Locating good key personnel is a difficult task. It is much more difficult to recruit and retain them. For this reason special inducements need to be offered to secure their continued services. Incentives such as a significantly higher salary than paid by industry, soft loans for home purchase, etc. are some of the items that will need detailed attention. Institutions within the regions may be prepared to release some of their staff to join the Centre. This could assist the recruitment problem.

Travelling within the region for consultations and discussions with a wide range of institutions, organisations, raw material and equipment suppliers will form one mechanism of co-ordination. The development of a two way flow of information is best achieved by person to person contact. For these reasons there will be need to make suitable provision for Regional travel and subsistance allowance. For the full 4 year perios of the project this is estimated at US $120,000.

ii. Training provisions

The Centre will arrange a programme of overseas training for its various staff members which can be later supplemented by international consultants being employed for short periods at the Centre.

(a) The Director of the Centre, who will be supported in his travel and subsistance expenses will undertake a familarisation study tour consisting of consultancies and visits to selected plastics technology institutes in Europe and USA to discuss and investigate prossible sister-institutional arrangements. An international technical consultant will accompany him on the tour to act as adviser, if required. All costs are based on 1985 data.

1.5 m/m	estimated cost of tour for Director	US $	7,000
	cost of consultant tour	US $	22,500

(b) The centre will select from the plastics technologists appropriate candidates who will be supported in their travel and subsistance expenses to attend technology training courses in specified subjects in overseas countries starting in Year 1. These courses will cover the following:

i. Plastics processing, formulations, compounding and recycling technology

3 m/m	estimated cost of training	US $	36,000
	cost of fellowship	US $	12,000

ii. Plastics product development and evaluation

3 m/m	estimated cost of training	US $	36,000
	cost of fellowship	US $	12,000

iii. Plastics testing and quality control

3 m/m	estimated cost of training	US $	36,000
	cost of fellowship	US $	12,000

iv. Plastics hand fabrications and FRP technology

1 m/m	estimated cost of training	US $	12,000
	cost of fellowship	US $	4,000

(c) The Centre will select two appropriate condidates who will be supported in their travel and subsistance expenses to attend a study tour consisting of consultations, demonstrations and visits to selected plastics in agriculture experiemental stations and institutes in Europe.

1 m/m each total 2 m/m	estimated cost of study tour	US $ 9,000

(d) The Centre, within the project period, will select a total of eight candidates from the Centre who will be supported in their travel and subsistence expenses to undertake a study tour to attend selected seminars, meetings, conferences, exhibitions etc. on plastics technology, plastics applications or related subjects, at various dates in overseas countries, or to visit sister institutions

Total 8 m/m	estimated cost of study tours	US $ 34,000

(e) The Centre will arrange for the technical information officer, who will be supported in his travel and subsistence expenses, to attend a training course in plastics technology information services at the Rubber and Plastics Research Association, Shawbury, Salop. UK.

2 m/m	estimated cost of training	US $ 24,000
	cost of fellowship	US $ 6,000

(f) The Centre will arrange for the marketing studies manager, who will be supported in his travel and subsistence expenses, to attend a training course in marketing in a selected Institute in Europe

2 m/m	estimated cost of training	US $ 24,000
	cost of fellowship	US $ 6,000

(g) Other unspecified overseas training requirements

	estimated cost	US $ 60,000
	Total training component costs:	US $ 352,500

The training courses should be arranged and undertaken as early as possible in the process of establishing the Centre. Apart from the actual training undertaken there will have been opportunities for developing contacts and friendships with other specialist technologists. This will be of great value in the future development of the Centre. Most training will be undertaken on a 1 for 1 basis.

iii. International personnel

To assist in the implementation of establishing the Centre it is highly desirable to utilise the services of a specialised international consultant who can from experience anticipate bottlenecks and more important know how to release them. He can assist the Director of the Centre with the preparation of the detailed equipment specifications, with the lay-out of the building, in preparation of study tours. On the other hand the Director does not want, nor will he wish to have a consultant around him all the time. This can be overcome by arranging for the consultant to operate on a split-mission basis which experience shows can be very successful. It is proposed that such a consultant should operate over a 3 m/m per year basis as the following job description clarifies.

(a) Technical adviser to the Director

He should be a plastics technologist with extensive experience in both a wide range of plastics processing technology, and also in application and development work. He should also be particularly experienced in the development of plastics applications and be familiar with the organisation and conduct of such experiments and trials and be able to collaborate effectively.

He must have managerial experience and be a skilled administrator since his duties will be the overall technical co-ordination of the project. Previous experience in developing countries is highly desirable. Language: English, Arabic an advantage.

He shall undertake his duties on a split-mission basis. Two visits of one month each shall be undertaken at the Centre, o.5 m/m utilised for maintaining continuity through appropriate communication consultancy from

out-station (home-base) and 0.5 m/m utilised to extend any of these activities as may be required by the Director.

The essential element is flexibility of arrangements to suit the project needs. If required, he will also accompany the director on his study tour as technical adviser, such time would be additional to the annual duty period.

Total time of consultant over 4 years: 12 m/m
estimated cost : US $198,000

(b) Consultants

Other consultants will be required by the Centre to provide specialised expertise during the first four year period of build-up. Some example description of consultants are set out in Annex E to assist in defining possible potential needs. These are by way of example only and do not in any way restrict the nature of the specialised expertise that may be required. Apart from performing or assisting in specific tasks consultants can also undertake on-the-job training of the Centre's staff.

It is estimated about 24 m/m of consultancy time will be required to support the Centre's activities in the first 4 years.

24 m/m estimated cost:	US $396,000
Total cost of consultancy inputs:	US $594,000

iv. Sub-contracts

(a) Sister institutional linkages

Experience shows that substantial benefits can be obtained by creating a continuous linkage with a similar specialised overseas institution.

There are a number of such institutions in Europe. Such linkages can be developed by direct contact, or in some cases as part of a bi-lateral arrangement though this might be more difficult for a Regional Centre. The sister institution can offer a wide range of services depending upon what the Centre exactly requires. It could offer specialised staff

training, exchange of technology information, technical documents, technical service. Interchange of one member of staff for at least 1 m/m (man/month) per year ought to be a minimum requirement during the formative years of the Centre.

Such co-operation needs to be clearly specified and it is usual to put this into the form of a contractual document and at an agreed fee for the services to be provided. This needs to be arranged by the Director of the Centre.

Estimated cost of sister institutional sub-contract

US $ 35,000 / year

Total cost US $105,000 / 3 years

(b) Plastics in agriculture study tour

The actual arrangements for this study tour can either be made by engagement of a specialised international consultant, or by employment of the services of the International Committee for Plastics in Agriculture (CIPA) in Paris on a sub-contract basis who can also undertake technical interpreter services in France.

Estimated cost of arranging study tour sub-contract

US $ 4,000

(b) Physical Resource requirements

(i) Buildings

The building requirements for the Centre can be divided into the following requirements:

- Offices, library and social services (35 rooms)
- A conference room
- Laboratories for testing and instrumental analysis equipment - some of the test-laboratories will need to be temperature controlled to $23^{\circ}C \mp 1^{\circ}C$.
- A large area for pilot-plant equipment - with adequate head room of about 8 m.

- Stores for raw materials and store for spare parts and engineering items. One store will need to be kept cool at $5^{o}C$ preferably $\pm 1^{o}C$ (for storage of polyester resins).
- Engineering workshop (tool room and fitting room)
- General purpose warehouse
- Provision for welfare services

As this will be a Regional Plastics Development Centre every effort should be made to include the maximum amount of plastics,where possible, in their design and construction. The design of the building must take account of the changing nature of the work that the Centre will undertake and flexibility of approach should be the guiding principle. Attention will also need to be paid to air-conditioning requirements and the need to reduce vibration and noise in the pilot plant area.

Special attention should be paid to health and safety aspects in the design stage of the building.

Attention will also need to be given to the provision of services in the pilot plant area and their layout bearing in mind the possible need of items of equipment from time to time. A high level of lighting is required in this area, both daylight and artificial.

The total area is estimated at 4,000 square metres and allocated as follows:

		square metres
1.	Administration	200
2.	Investigation/testing labs	140
3.	Offices	160
4.	Stores	60
5.	Engineering workshop	50
6.	Utilities	40
7.	Conference room	120
8.	Pilot plant area	900
9.	Parking area	250
10.	Open air access (for out-door experimental work)	580
11.	Roads and pathways about	1,500
		4,000

Of this area 1,670 square metres are included in the building area. Additional land may be required for expansion at a later stage.

The total cost of the building including site preparation, civil engineering and external fencing is estimated at US $1,274,000. This cost is based on a building cost of US $700 per square metre (1985 price) and roads, surface finishing etc. at US $60/square metre (1985 price). However, this price should be regarded merely as giving some indication of magnitude since it will depend on the actual location selected for the establishment of the Centre, and the amount of facilities that the host Institution is able to offer.

No cost has been included for the land.

No drawing has been prepared for the layout of the Centre since this will be finally determined by the Director, advisedly in consultation with an international consultant, when the host institution facilities have become known.

(ii) Equipment

The equipment requirements of the Centre have been detailed and set out in Annex D. This covers the expendable equipment and supplies, as well as the non-expendable equipment. The latter is set out in appropriate groups relating to the sections of the organisation which require the specified items. Names of sources of supply are indicated as well as the time that delivery is required. The price is also given against each scheduled item. This generally includes packing and cif. Most prices are based on late 1984 data.

The list also covers the office equipment and furnishings as well as telephone and telex.

The actual equipment that will be ordered can only be determined once the location and site for the Centre has been finalised. It is perhaps necessary at this point to re-call it is the intention to place the Centre within the umbrella and site of an existing institution. Therefore, until the facilities and equipment which can be shared with the host institution

are known and detailed it will not be possible to finalise the equipment list. However, once this information becomes available the Director of the Centre, with the assistance of an international consultant can then start to prepare the detailed specifications which are required before invitations to tender can be issued.

It may be of assistance to mention that UNIDO have specialised experience in placing tenders, undertaking technical assessments of bids and placing orders for such specialised equipment items. They have available names of reputable companies to approach and many years experience in this type of operation. It may be advisable therefore, to consider the use of UNIDO's specialised experience for the purchase of equipment, on selected items of equipment.

As detailed in Annex D the costs are totalled as follows:

Expendible equipment	US $ 84,000
Non-expendible equipment	US $1,995,100
Equipment T O T A L	US $2,079,100

It should be noted that not all items of process equipment shown on the organisational chart (Annex C) are included in the equipment list. This is because they appear in the information available to be of a lower order of priority and could be included in the next phase of the development of the Centre.

The possibility of utilising existing equipment in local factories should not be overlooked when special problems present themselves. If local contacts are correctly fostered the good-will of local facotries can often make a significant contribution to extending the range of activities of the Centre. However, sometimes it is necessary to pay, or replace, raw materials used, or to make financial compensation for production time lost. Much will depend on the nature of the operations undertaken. A sub-contract allowance need to be provided to cover this eventually.

Cost of use of facotry equipment and materials sub-contract

US $15,000 (over 3 year period)

(c) Financial resource requirements

The basis of the cost estimates are stated in the relevant sections and an attempt has been made to use the most up-to-date information available. Some has been provided through AIDO or UNIDO, or from other sources.

(i) Total cost of the project

This is defined against each heading and covers the stated costs. It does not however, cover any of the running costs such as rates, local taxes (if any), he ng, electricity, water, sewerage, drainage, telephone, telex, charges et' No social security charges have been included in salaries or wage: .

	Subj·	Cost in US Dollars
(1)	Building and civil works	1,274,000
(2)	Equipment, machinery and supplies	2,079,100
(3)	Personnel salaries and wages	2,301,765
(4)	Regional travel and subsistance	120,000
(4)	Training provisions	352,500
(5)	International personnel	594,000
(6)	Sub-contracts	134,000
(7)	Miscellaneous and contingencies	69,635
		6,925,000

(ii) The Budget of the Centre and Financing

The time span allocated for establishing the Centre is four years. At the end of this period it is expected that it will require to be expanded.

An annual budget estimate will need to be prepared by the Director and submitted to the Governing Board for its approval. The preparation of the budget should be one of the first tasks undertaken by the Director. It should include cost of normal running of the Centre, salaries, wages, travel expenses, utilities, services, consumable materials and depreciation charges on equipment etc.

AIDO have stated that they will take up the question of financing for the Centre and this item does not therefore require to be developed in this document.

12. Project implementation

(i) Institutional Framework

(a) Standing Committee

As already indicated the first task will be to establish a Standing Committee of about four or five members who will be potential members of the Governing Board when it is formed. The tasks to be undertaken by the Standing Committee include:

1. Take charge of the funding operations for the Centre, obtain commitments, make appropriate banking arrangements,
2. Finalise the location for the centre
3. Identify and recruit a Director for the Centre
4. Arrange a request to be made to recruit a specialist international consultant to act as adviser to the Director (this can be done through AILO or UNIDO)
5. By appropriate consultations expand the membership of the Standing Committee and arrange for the formation of the Governing Board to be established. This will be deemed to be the starting point for the establishment of the Centre.

(b) Governing Board

The Board will make financial appropriations and release funds in such a manner as may enable the Centre to meet its financial commitments in respect of the project as and when they fall due. In this respect a sum equivalent of US$30,000 will be deposited in a bank account in the name of the Regional Plastics Development Centre (E) as a starting point for funding a rotating account. The deposit shall be made at the start of the project.

The Board will ensure that the Director for the centre has been selected and identified so that he is available at the start of the project.

A sketch plan of the land, and any building, which is to be made available to the project by the host institution shall be deposited with the Board. Any legal obligations shall be duly recorded and registered with the Board.

The Board will be responsilbe for the policy and co-ordination necessary to meet the objectives of the project, as set out in this document, preparing reports, evaluating the progress of the project and reporting to AIDO about the project. It will be the administrative body controlling the policy of the Centre and will thus have the authority necessary to make such changes as may be required to ensure that the Centre fully serves the interests of the plastics industry in the future.

The Board will also be the Governing Board of the Regional Plastics Development Centre (W) and thus will ensure, a high degree of co-operation and co-ordination is maintained between the two Centres.

(ii) Appointment of the Director of the Centre

The Director will need to undertake the following tasks within the first few weeks of his appointment.

1. Locate temporary accomodation until the Centre buildings become available.
2. Start recruitment of key personnel including a personal secretary.
3. Prepare four year programme for development of the Centre.
4. Prepare the budget estimate for the first year.
5. Start discussions with host institution and architect re plans for building requirements.
6. Ensure an international consultant has been made available to him to act as adviser.
7. Make arrangements to undertake familiarisation study tour.
8. Ensure satifactory banking and financial arrangements have been made by the Board.
9. Start the revision of the workplan once the final format of the Centre has been decided.

(iii) Workplan

An outline workplan in the form of a bar chart is set out in Annex F.

The main R + D priority items which have been identified are as follows:

a. Development of long-life plastics film for greenhouse covering.
b. Development of wood-substitutes. Specifically required is the development of plastics window frames to withstand the severe Arab environment in the Eastern region.
c. Identification and development of new products (which can be manufactured on existing processing equipment) into new market areas.
d. Technological and technical support to national standards organisations in the development of performance specifications for both agricultural and industrial products.
e. Identification of the institutions, organisations, universities and raw material producers in the Arab world who have technological facilities for development of work on plastics (not polymer research and development) who are currently working on plastics problems. Establishment of co-operative links with selected units, when identified.
f. Establishment of close co-ordination link with Regional Plastics Development Centre (W). Assistance with "continuing training" requirements.

(iv) Activities

Description of the project activities	Starting date / Duration
1. Formation of Governing Board	Year 0/4
2. Appointment of Director of the Centre	Year 1/1 onw.
3. Appointment of International consulant as adviser to Director	Year 1/1 (on split mission/consultation basis, 3 m/m per year)
4. Provision of expert-selection of books and journals plastics technology library service	
5. Development of a policy statement for the Centre to be approved by the Governing Board and implemented	6 months Year 1/2 and 3
6. Development of suitable organisational structure for the Centre and modified as necessary from time to time	6 months Year 1/2
7. Identification and development of necessary managment functions, objectives and tasks which includes policy-making; administrative(including resources management) financial, programme managment; evaluation and forward planning, co-ordination and relations with governing authorities, Government, other organisations and institutions etc.	
8. Preparation of staff profile document in co-operating job objectives, task descriptions, qualifications, and experience required and other elements of a profile of staff needed for operating the Centre at optimum level and its implementation	12 months Year 1/3
9. Appointment of National Staff	Year 1 onw.
10. Provision of fellowships 14 m/m for overseas training	Year 1/4 onw. (depends on arrangements to be made)
a. Processing/formulations	3 m/m
b. Product development and evaluation	3 m/m
c. Testing and quality control	3 m/m
d. Handfabrication and FRP technology	1 m/m
e. Plastics technology information services	2 m/m
f. Marketing studies for plastics	2 m/m
11. Preparation of a technical manual to support the development of a document detailing the outputs profiles of the Centre for a 4 year period of the project and explaining (a) the approach, methods and techniques as well as the information and data to be used in preparing the outputs forecast document; (b) how the approach, methods and techniques, and what kinds of information and data should be used to modify the established profile of outputs; and (c) what kind of machinery should be established within the Centre to review, and modify as necessary, the outputs from time to time	3 months Year 1/4

Description of the Project activities	Starting Date/ Duration
12. Preparation of an outputs profile document to be approved by the Governing Board and implemented, indicating the following: (a) the different types, categories and levels of outputs (products or services) which the Centre will produce over a four year period; (b) The quantitive and qualitative attributes of the outputs which will be produced; (c) a time-phased schedule, where applicable, for the production of the different outputs (d) The justification for the production of the different ouputs, i.e. justification of categories quantities, qualitative attributes and schedule	Year 1/2 onw.
13. Preparation of a manual explaining the approach (a) the techniques as well as the information and data to be used in developing the various elements which constitute the Centre programme for applied research; (a) how the approach, methods and techniques and what kind of information and data should be used in modifying the established programme; (b) what kind of machinery should be established within the Centre to review, and modify as necessary, the programme, from time to time, and (c) which users or groups of users of the Centre's outputs or services should be consulted; and through what means, in regard to the contents of the programme and their modification.	Year 1/3 3 months
14. Preparation of the Centre's plastics technology programme setting out the purpose and scope of the applied research programme; the specific applied research activities or fields of applied research, the methods and techniques to be used; the information data and related materials to be used; selection and scheduling of applied research activities or projects These programmes will be expected to be designed to: (a) increase productivity on indigenous equipment (b) improve quality of products (c) establish parameters for product performance (d) initiate and draft quality standards (e) evaluate raw materials, finished products, processes equipment and applications	Year 1/2 onw.
15. Development of co-ordination and co-operation with the Regional Plastics Development Centre (W) - Formation of a co-operative committee -	Year 1/2 onw.
16. Preparation of job descriptions and training schedules for short-term consultants required for the Centre development programmes implementation; in total of 24 m/m.	Year 1/4 as required onwards
17. Building and offices (a) planning (b) building operations and civil works	 Year 1/2 and 3 Year 1/4 (completion end Year 2)

Description of project activities	Starting date/ Duration
18. Establish stores, inventory and stock control records	Year 2/4 one month
19. Instali office equipment and supplies	Year 2/4 as required
20. Establish Centre organization and management functions: allocation of personnel	Year 1/3
21. Installation and testing of equipment, checking and listing spares	Year 3/1
22. Collection and indexing of service manuals provided by machinery and equipment suppliers	Year 3/1 as required
23. Preparation of annual budget estimates	Year 1/4 Year 2/4 Year 3/4 Year 4/4 3 months each year
24. Initiation of discussion group meeting involving plastics technologists and counterparts from Agricultural Research institutes to interchange information, ideas and experience. To develop co-ordination and co-operation in work programmes for developing and extending the use of plastics in agriculture.	Year 2/2 and twice yearly
25. Provision of international fellowship for a senior staff member for Study Tour and consultations with European plastics technology institutions. Consultations and visits to selected plastics machinery and processing factories accompanied by the International Adviser, if required	Year 1/1 and 2 1.5 m/m
26. Preparation of manual routine preventive maintenance. Implementation with schedules and records.	Year 2/2 onw.
27. Preparation of physical resources document setting out the following, and appropriate up-dating: (a) an itemized list of buildings and other physical plant needed with descriptions thereof in adequate detail, and with an indication of the parties responsible for carrying out repairs, etc., under contractual arrangements; (b) an itemized list of machinery and equipment and related spares needed, with specifications in adequate detail; a list of sources of supply of the machinery and equipment and related spares; and information on servicing agreements entered into with the institution by suppliers or other organizations; (c) an itemized list of expendable equipment and supplies, together with an indication of their purpose, sources of supply, optimum inventory levels, and storage and distribution arrangements; (d) a description of any programme of maintenance established, its purposes, mode of execution, roles of different units of the institution in it, roles of any outside parties in it, etc.; and	Year 1/3 onw.

Description of project activities	Starting date Duration
(e) Description of the organization and procedures implemented to plan, procure, control and manage the physical resources of the institution	
28. Preparation of a revenue sources document incorporating alternative and recommended proposals concerning sources of revenue and the arrangements for obtaining needed finances. This should include proposals, together with explanations of implications, on such matters as fees (e.g., for trainees, research and consultancy services) scholarships or fellowships and official subventions.	Year 1/4 as required
29. Execution of development programmes	Year 2/1 onwards
30. Develop an evaluation, testing and technology support service for the regional industry	Year 3/1 onw.
31. Develop contacts with plastics raw material and machinery suppliers, with trade associations and appropriate Government organisations	Year 2/2
32. Provision of short term international specialist consultants	Year 2/1 onw. as required
33. Preparation and implementation of a system of Centre Staff induction and development	Year 2/1 onwards
34. Initiation of discussion group meetings involving plastics technologists and counterparts from specific sectors of industry (as users of plastics products) to interchange information, ideas and experience. To develop co-ordination and co-operation in work programmes	Year 2/2 at regular intervals
35. Investigate and identify areas of potential use of plastics in agricultural and industrial development	Year 2/3
36. Provision of 2 fellowships for Study Tour and consultations at selected European plastics agricultural institutions. International Adviser as technical leader for the Study tour, if required.	Year 2/1 and 2 3 m/m (Note: this tour is season dependant)
37. Design and execute programmes for development of applications, particularly in: (a) Agriculture-development of long-life plastics film for greenhouses (b) Building and construction - development of plastics window frames (c) Packaging - identification of market requirements (d) Evaluation of new and existing products (e) Demonstration of applications and training in installation for end use	Year 3/1 onwards
38. Development of sister institutional arrangements in plastics technology to ensure continuous interchange and updating of technical and technological information and services. Provision of specialised experts at short notice. Regular visits to sister institutions.	Year 1/3 onwards

Description of project activities	Starting date/ duration
39. Preparation of long-term and perspective financial plan for the Centre to be approved by the Governing Board and implemented	Year 2/2 one year
40. Preparation and implementation of a system of staff assessment	Year 2/2 onwards
41. Preparation and implementation of a comprehensive plan approved by the Governing Board for the phased development of the Centre as a whole, specifying to what extent and how each of the specific aspects are to be further developed.	Year 2/2 onwards
42. Promote and assist introduction of quality control at regional plastics processors	Year 3/2 onwards
43. Commence technical information publications for the plastics processors with particular reference to small scale and potential entrepreneurs	Year 3/1 onwards
44. Provision of fellowships for overseas technical study tours and visits to sister institutions	Year 2/1 onwards
45. Design, develop or improve plastics products for specific agricultural applications at optimal cost/performance ratio	Year 3/2 onwards
46. Transfer the technology of improved processing, products or applications to processors and user through demonstrations and training, lectures, seminars, workshops, industrial clinics and literature as appropriate	Year 2/4 onwards
47. Project mid-term review	Year 3/1
48. Annual reports	Year 1/4 Year 2/4 Year 3/4 Year 4/4

13. Ouputs to be achieved

(Note: the outputs of this project include both the outputs of the institution-building operation as well as the outputs of the Centre's own programmes).

1. Establishment of a Regional Plastics Development Centre (E), controlled by a Governing Board, with an established organisational structure and functioning management guided by an approved policy and implementing a comprehensive plan for the development of the Centre.
2. Buildings containing offices, lecture hall, laboratories for pilot plant, testing equipment, stores, information and marketing resource facilities, and engineering services.
3. Machinery, equipment and supplies, in place, tested and in use.
4. An inventory of expendable equipment and supplies, stores and an operationally active stock control and purchasing system.
5. Trained staff personnel in thirteen specialized areas of plastics technology, one in technical information services and one in marketing services.
6. Interim and final reports of the development work, in hand, or completed, undertaken by the Regional Centre.
7. Nine active documents, approved as necessary, covering the following:
   (a) Ouput profiles of the Centre for a four-year period
      1. Improved products and extended applications of plastics in agriculture, and in industrial applications.
      2. Improved productivity of processors.
      3. Introduction of quality control in plastics processing operations.
      4. Production of quality controlled plastics products.
      5. Draft regional standards for plastics products in both agricultural and industrial applications.
      6. Improved, extended and constantly up-dated knowledge of the application and technology of plastics in agriculture and industrial market areas.
      7. Interchange of knowledge, ideas, technology with other related institutions.

(a) Physical resources inventory and management

(d) Long-term financial plan

(e) Revenue sources

(f) Annual budget estimates

(g) Staff profile needs of the Centre

(h) Induction and staff development

(i) Staff performance assessment

8. Three manuals containing information and data covering the following:
   (a) Establishing the profiles of outputs for the Centre
   (b) Routine preventive maintenance procedure
   (c) Developing elements for the centre's technology development programmes.
9. Report of the study tour to plastics in agricultural experimental stations, an contacts established
10. Report of the study tours to plastics technology institutions and contacts established.
11. An operationally active sister-institutional arrangement with an overseas institution for effecting inter-change and updating of plastics technology.
12. A document setting out the basis of collaboration with the Regional Plastics Development Centre (W).
13. Documents setting the basis of co-operative agreements with selected scientific institutions or organisations within the Region.

14. Regional Plastics Development Centre (W)

As already indicated in the earlier part of the text the Plastics Department in the Algerian Petroleum Institute (IAP) already has on-going and established courses in plastics for technician, higher grade technician and a post-graduate course for Masters Degree in Plastics. The technician courses are for 2 years, higher technical 3 years. They have run the courses for a period of nine years using technical expertise under contract from the Stevens Institute of Technology, USA. As the international working language for plastics is English and the majority of plastics technology publications are in English language the courses are therefore conducted in English language. Should Arabic be the preferred language for such training then suitable arrangements could no doubt be made for teaching in Arabic. This would also involve translation of texts and books into Arabic, which would involve additional overhead charges. The Plastics Centre has trained about 10 technicians per year since starting. The Institute possesses on site accomodation for trainees. Through bi-lateral agreements with the Algerian Government some students from other African countries have also been trained.

The need of "continuing training" has been recognised and the method proposed of placing pre-fabricated buildings at each of the plastics production areas in Algeria to enable training to be undertaken close to the factory creations has been discussed in the earlier part of the text. Also the idea of developing totally mobile training units to achieve the same objective has also been discussed in the earlier part of the report.

In the time available in Algeria it was not possible to obtain additional information nor to visit IAP at Boumerdes. It is necessary that the mechanics by which the Regional Plastics Development Centre (W) could be developed as an autonomous Centre within IAP as the host institution should be investigated and this will involve discussions with Government Ministries involved as well as with IAP. Without doubt this is the most natural location for establishing the Regional Plastics Development Centre (W). Training is the one constraint which is given highest priority by all the persons contacted during the course of this mission. Observations of equipment damage in factories and other information confirm that there is an urgent and immediate need for 'continuing training', that training

of technicians, higher technicians and postgraduates in plastics will be required now and for the medium term to enable the plastics industry to utilise the new technologies that will be developed by the Regional Plastics Development Centres (E) and (W) with applications into industry and agriculture where performance of the product will be the determining factor. Without a flow of such skills becoming available it will not be possible to increase productivity at a time when the market moves to a buyer's market and competition brings economic pressures upon the industry.

It is therefore strongly recommended that,

(1) The Regional Plastics Development Centre (W) should be established at the Plastics Department of the Algerian Institute of Petroleum at Boumerdes, Algeria. This has on-going training courses and facilities in plastics, and also has local accomodation facilities for students.

(2) AIDO should request the services of a UNIDO consultant for a one month mission to Algeria for technical and administrative discussions with appropriate Government Ministries and Departments to obtain the necessary information to prepare and complete a project document for the Establishment of the Regional Plastics Development Centre (W) at Boumerdes, Algeria, and the financial input required.

(3) AIDO should draw the attention of appropriate Arab Governments or organisations and in particular of Algeria and Iraq, where physical resources for mould-making are installed, the need to develop long term plans for the training of very specialised craftsman in mould-design and mould-making (including extrusion dies) for the plastics industry.

The mould-design and mould-making industry is a very important auxillary industry on which the long-term success and development of the Arab plastics industry will depend.

(4) AIDO should undertake a feasability study to determine the cost and the technical requirements to develop mobile training units required for undertaking 'continuing training' operations which require the training facilities to be located within easy access of plastics factories.

These units could also be utilised for demonstration and technology transfer of adapted or new products, processes or applications thus serving the requirements of both Regional Centres.

E. ACKNOWLEDGEMENTS

The consultant wishes to experess his thanks and sincere gratitude to Mr. Adnan, KINDI, Director General and to Dr. Abdul Karim Belkora, Director of Studies Development of AIDO for their active support for this project. Also his very many personnal thanks to Dr. Mohamed HAOUARI who as counterpart so very ably arranged the overseas visits and accompanied the consultant on the visits in Iraq. He gave unstintedly of his time and without whose help and assistance the mission would not have been completed. Thanks are also expressed to Dr. Salah Ronag, Director of the AIDO Regional Office in Algiers for his support for the project,and many personal thanks are due to Dr. Abdul Hessin Shlash who arranged visits and accompanied the consultant on the visits. His help and assistance, his background knowledge so freely given were very much appreciated in developing a detailed picture in a relatively short period of time. Personal thanks are also expressed to all the AIDO personnel and experts both in Bagdad and in Algiers who not only so willingly co-operated with the consultant in the provision of information, but all made his stay such a warm and pleasant one.

The consultant also wishes to express his thanks to all those persons, too many to name individually, in Ministries, Institutions, organisations and factories in Algeria, Kuwait, Iraq and Saudi Arabia who contributed to the development of this study through the wide range of detailed information provided so generously.

Thanks are expressed to Mr. George AbuJawdeh, Resident Representative, and Dr. A.K. Surani, Deputy Resident Representative of the UNDP office in Bagdad for their kind help and advice and to all the members of their staff who provided assistance during the course of this mission. Thanks are also expressed to Dr. Hassan Amin and Mr. Shah, and other members of the staff of UNDP office in Riyadh who so kindly arranged additional visits, and provided further background information, and provided much assistance to the consultant during his short stay there. Further, thanks are due and expressed to Mr. Julian Whaley Resident Representative, Mr.

Salahie, Deputy and to Mr. Hibadj and other members of the staff of the UNDP office in Algiers for all their kind co-operation and provision of information.

In all these UNDP offices, in Bagdad, Riyadh and Algiers one was made to feel at home, and nothing was too much trouble to arrange. There was a genuine warmth to the welcome received which made the task of rapid travel that much easier. Many thanks to all of you are expressed.

Finally, sincere thanks are expressed to a wide range of personnel at UNIDO, Vienna who assisted this mission in various ways and provided back-stopping activities. Your kind help and assistance has been much appreciated.

Plastics Processing

List of some of the laboratory facilities available in the Arab region

1. Algeria

IPA - in the plastics section has a range of testing equipment.

NEPC (factory) has facilities for testing of pipe and film.

2. Egypt

PDC (Plastics Development Centre) range of test equipment and pilot plant for plastics. Application facilities.

3. Iraq

NCPC (National of Plastics and Chemicals) has range of test equipment for some plastics products. Currently planning to start own R + D system.

National Organization for Petroleum and Chemicals, at Basra, has both testing and pilot plant equipment for plastics.

4. Jordan

RSS - range of test equipment for some plastics products. Pilot plant injection moulding unit.

5. Kuwait

KISR - range of laboratory equipment of plastics including weatherometer, colour analysis, small 2-Rollmill; range of test equipment for some plastics products.

6. Saudi Arabia

SABIC - Marketing services have a range of pilot plant equipment.

University of Dharhran - Pilot plant for plastics.

SASO - Range of test equipment for plastics for which specifications have been published. Covers PVC pipes and plastics covered cables.

FABCO - Range of test equipment for plastics pipes and formulation development.

Visits made to organizations and persons interviewed

1. Ministry of Light Industries — Iraq
   National Chemical and Plastics Industries Co., SA
   Eng. K.A. As-Sultany - Technical Assistant, Managing Director
   Eng. Ali Abdul Raheem, Manager R + D

2. State Organization for Chemical Industries — Iraq
   Dr. Jalal Al-Hashimi, R + D Manager
   Dr. Farhenk Jalal, Expert Petrochemicals in Iraq Government

3. AIDO — Iraq
   Many members of staff and experts at the Organization all contributed to technical discussions.

4. State Organization for Construction Industries — Iraq
   Eng. Nizar

5. Ministry of Industry and Minerals — Iraq
   Dr. Farhenk Jalal - New projects

6. Central Organization of Standards and Quality Control — Iraq
   Dr. Khalid Unis, Acting President

7. Scientific Research Council — Iraq
   Baghdad - Jadriah
   Solar Energy Research Center
   Director: Mrs. Nidal Hamadani

8. Kuwait Institute of Scientific Research — Kuwait
   Dr. Saed Akashah, Division Director, Petrochemicals and materials
   Dr. Shawqui Lahalih, Manager, Products Department
   Mdm. Laila Kamel, Head, International Programmes Office
   Mr. Bader Nasser Al-Hajji, Head, Public Relations
   Mr. Haitham Al-Hussain - Marketing

9. Petrochemical Industries Co. (K.S.C.) — Kuwait
   Dr. James Veitch, Manager - Planning
   Mr. Kenneth Emsden - Polymers

10. Organization of Arab Petroleum Exporting Countries (OAPEC)
    Dr. Zurhair Kacer, Head of Department — Kuwait
    Mr. Tayeb Ounada, Senior Petrochemicals Engineer
    Mr. Allam Kilani, Petrochemicals Project Engineer

11. Saudi Basic Industries Corporation (SABIC) — Saudi Arabia (Riyadh)
    Dr. A.A. Al Garawi, Director, Project Evaluation Department
    Dr. Mohammad A. Al-Kusyair, New Projects Manager

12. Saudi Consulting House — Saudi Arabia (Riyadh)
    Mr. Abdulaziz A. Khathan, Vice President - Economic and Administration Consultancy
    Dr. A.B. El-Shafir Darwish, Chemical Industry Expert

13. Ministry of Industry and Electricity — Saudi Arabia (Riyadh)
    His Excellency Mubarek Al-Khafrah, Deputy Minister
    Dr. Ranjith M. Withana, UNIDO expert, Industrial Planning

14. Saudi Arabia Standards Organization (SASO) — Saudi Arabia (Riyadh)
    Mr. Bader Saad, Director
    Mr. Khaled B. Amin, Head, Chemistry Section
    Dr. Rashid
    Dr. Banam

15. National Industrialization Company — Saudi Arabia (Riyadh)
    Mr. Khalid A. Al-Thukair, Director General
    Dr. Farzukh S.M. Akhtar, Chemical Engineer

16. UNDP office, Riyadh — Saudi Arabia
    Dr. Amin
    Mr. Nadir Hadj-Hammou, Programme Officer

17. A. Fouad and A. Busbate Co.Ltd. (FABCO) — Saudi Arabia
    Mr. Abdulla S. Busbate - Owner Partner
    Dr. Tahir M.S. Taher - General Manager
    Mr. Salah Darabseh - Plastics Engineer

18. UNDP office, Algiers — Algeria
    Mr. Julian Whaley, Resident Representative
    Mr. Mohammed Salahie, Deputy Representative
    Mr. Hibadj, Programme Officer

19. AIDO office, Algiers — Algeria
    Dr. Salah Rouaq
    Dr. Abdul Hessin Shlash

20. National Organization for Plastics and Rubber Industry (ENPC)
    Mr. Benakica Belkaccui, Chief, Planning Dept. — Algeria (Setif)
    Mr. Hihat Larbi, Chief, Technical Dept.

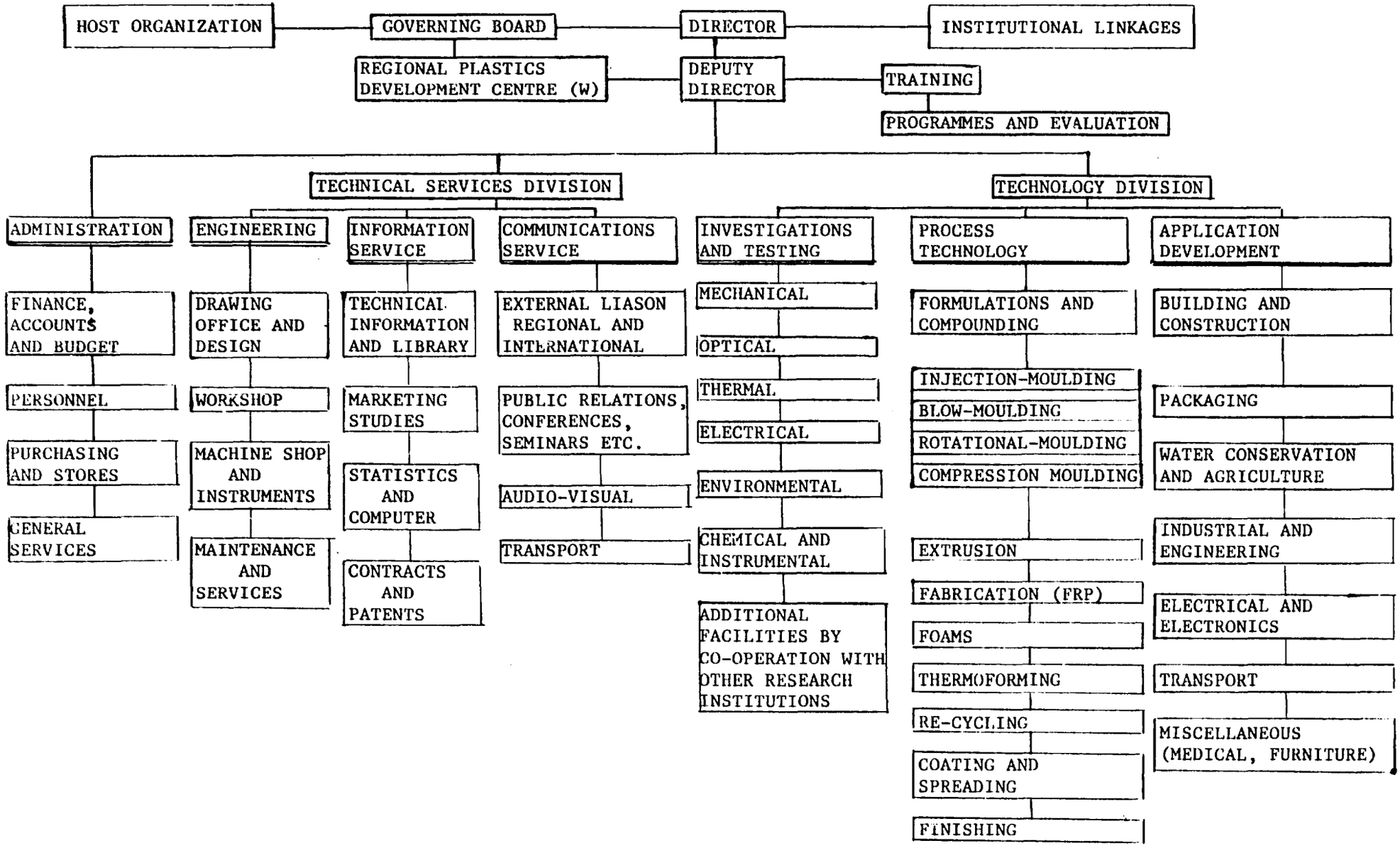
21. Ministry of Energy and Petrochemical Industries — Algeria (Algiers)
    Dr. Benoboura, Deputy Director, MEICP
    Dr. Djehri, Director, Research Centre, MEICP
    Mr. Yahjaoui, Chief, Research Unit on Polymers
    Mr. Hamada, Public Relations

22. Education International — Algeria (Algiers)
    Dr. Nandor Siskovich, Director General, IAP Project Algeria

ANNEX C

REGIONAL PLASTICS DEVELOPMENT CENTRE (E)

ORGANIZATION CHART



ANNEX D

EQUIPMENT LIST

Expendible equipment and supplies

Description	Delivery	Cost in US dollars
1. Raw materials and semi-finished goods	as required	15,000
2. Special grades of raw material	as required	22,000
3. Film, pipes, fittings etc. for comparative trials	as required	10,000
4. Miscellaneous items	as required	6,000
5. Office supplies (paper, carbons, pencils, etc.)	as required	6,000
6. Acquisition of technical information through access to data-banks (contract)	Year 2, 3 + 4	25,000
	Total	84,000 US dollars

Non-expendable equipment

Product Testing Unit	Source	Delivery	Cost in US dollars
1. Metrology equipment (thickness meters, temperature indicators, pyrometers, etc., pressure indicators and recorders, travelling microscope)	various	Year 2	5,000
2. Density column	Davenport, UK	Year 2	3,500
3. Shore hardness tester	Davenport, UK	Year 2	400
4. Balance, single pan, automactic tare 0-1, 0-3 and 0-5 kg. to 1 mg. accurac accuracy	various	Year 2	1,500
5. Test specimen cutting knives	various	Year 2	2,000
6 Melt flow indexer, accessories and sprays	Davenport, UK	Year 2	9,000
7. Tensile tester with accessories for tensile strength, elongation at break modulus, compression net (D638-68, D695-69, D790-70)	Instron, UK	Year 2	85,000
8. Elmendorf tear test (D1004-66)	Davenport, UK	Year 2	2,800
9. Non-contact temperature indicator (infra-red)	Germany	Year 3	10,000

10.	Brabender Plasticorder complete with recording unit, accessories and spares (measures plastics viscosity/temperature)	Brabenden, FRG	Year 2	48,000
11.	Low temperature torque - Clash and Berg apparatus	Davenport, UK	Year 2	6,000
12.	Pressure tester for pipes (short term test) and fittings	various	Year 2	2,000
13.	Volume and surface resistivity	Yarsley, UK	Year 2	6,000
14.	Haze and optical meter with accessories	Gardner, USA	Year 2	15,000
15.	Oven, electrically operated up to 200°C ∓ 2°C with shelves and fan ventilated. Stainless steel internally	various	Year 2	4,000
16.	Dart impact tester (for film)	Davenport, UK	Year 2	5,000
17.	Environmental stress cracking apparatus	Yarsley, UK	Year 2	10,000
18.	Stereomicroscope, with accessories and camera	Japan, FRG	Year 2	8,000
19.	Universal Izod impact test with accessories and spares (D256-70)	various	Year 2	13,000
20.	Moisture vapour permeability	Yarsley, UK	Year 2	1,000
21.	Gas permeability (D1434-66)	Davenport, UK	Year 2	2,000
22.	Long-term pressure tester for pipes at predetermined temperatures	various	Year 2	55,000
23.	Vicat softening tester	Davenport, UK	Year 2	8,000
24.	Weather-o-meter with Xeon light source (3 station unit) and spares	Hannau, FRG	Year 2	28,000
25.	Electrical tracking resistance	various	Year 3	10,000
26.	Voltage breakdown resistance	various	Year 3	50,000
27.	Flammability tester	various	Year 3	8,000
28.	Compression press for preparation of samples	various	Year 2	8,000

29.	Punch press for specimen cutting	Franck, FRG	Year 2	5,500
30.	Router-cutter for specimen preparation	Franck, FRG	Year 2	6,000
	Pilot plant for compounding			
31.	Two-roll mill, with speed differential and even speeds (approx. 15 x 30 cm rolls)	various	Year 2	100,000
32.	Multipurpose 100 ton hydraulic press, fitted with automatic programming, pattern size approx. 350 x 350 mm, fitted with heated and water cooled patterns	various	Year 2	55,000
33.	Powder-blender, Kenwood type	Kenwood and Hobart	Year 2	3,000
34.	Balance: 0-1 kg single pan type	various	Year 2	2,500
35.	Scales: 0-5 kg direct reading	various	Year 2	2,000
36.	High-speed mixer (6-10 litre)	Papenmeyer, FRG	Year 2	22,000
37.	Spares and miscellaneous items of equipment for compounding			5,000
	Pilot plant for processing			
	Extrusion unit			
38.	Multipurpose 32 mm extruder, variable speed controlled screw, fitted with pressure and torque sensors, indicators and recording equipment. Modulur unit, fitted with adjustable slot cooling rings, one for 32 mm extruder-die position and one in bubble length.Modular unit fitted with film assembly unit with adjustable height nip-rolls, take-off unit for centre and surface wind-up, and equipped with air blower unit. Modular unit and rotating die for blown film extrusion and assembly trolley modular unit	Betol, UK	Year 2	96,000

39.	Co-extrusion 3 layer film unit. Two 25 mm extruders for co-extrusion plus one 32 mm extruder fitted with die with triple adjustment rings for accurate layer uniformity. Fitted with facilities for internal bubble cooling. Modular unit fitted with film tower of maximum height 5 metres and handling film 400 mm wide. Modular unit fitted with Nip roll haul-off unit of adjustable height and fitted with gusset boards, flattener boards and adjustable guidepath rollers.	Betol, UK	Year 3	120,000
40.	Granulator	Betol, UK and others	Year 2	6,000
41.	Magnetic separator	various	Year 2	3,000
42.	Film waste re-pelletiser (high sheer unit)	UK and FRG	Year 2	13,000
43.	Temperature controlled fluidized bed for burning off dies etc.	Techne, UK	Year 2	13,000
44.	Multi-purpose 50 mm extruder with variable speed controlled screw, fitted with pressure and torque sensors, indicators and recorders. Modular unit with tube head die. Modular unit with vacuum sizing and water-bath with air knife and water cooler modular unit with caterpillar haul-off and cutting saw and fitted speed indicators. Modular unit with twin drum coiling machine complete with controls	Betol, UK	Year 3	80,000
45.	Dies for pipe and section extrusion	Betol, UK and others	Year 3	10,000
46.	Antistatis bars	various	Year 2	4,000
47.	Additional extruder screws (4)	Betol, UK	Year 2	10,000
48.	Spares, and miscellaneous items for extruders			12,000
	Injection Moulding Unit			
49.	Automatic injection machine 60 ton clamping pressure, 200 gm shot capability. All hydraulic operation	Windsor, UK	Year 2	32,000

50.	Test moulds	various	Year 2	8,000
51.	Automatic injection moulding machine air-pneumatic operated, 25 gm capacity with test moulds	Austin Allen, UK and others	Year 2	16,000
	Blow moulding unit			
52.	Blow moulding equipment with one table action	Bekum and others	Year 3	60,000
53.	Test moulds	various	Year 3	6,000
54.	Mould cooling unit	various	Year 3	8,000
	Fabrications unit (FRP/GRP)			
55.	FRP spray rovings equipment with accessories	Covenhove	Year 3	20,000
56.	Hand tools for hand-layup and accessories	various	Year 3	1,000
	Plastics fabrication workshop			
57.	Impulse heat sealer	various	Year 3	2,300
58.	Ultrasonic sealer with set of sealing tools	various	Year 3	15,000
59.	Hand fabrication equipment for plastics pipes, jointing, bends, etc.	various	Year 3	12,000
	Recycling waste plastics unit			
60.	Plasticator for recycling of mixed plastics waste	F.N. Herstal, Belgium	Year 2	60,000
	Thermoforming unit			
61.	Vacuum, pressure operated multipurpose thermoformer with set of moulds and complete with necessary vacuum pump and spares	various	Year 3	8,000
	Foam unit			
62.	Vacuum oven	various	Year 3	6,000
63.	Pre-expander	various	Year 3	5,000
64.	Multi-component mixing unit and mould former		Year 3	13,000

Investigations unit

65.	A range of instrumental analytical equipment covering Infra-red and Ultra-violet spectroscopic analysis, microblance, gel permeation, liquid and gas chromotography Differential thermal analysiser, polaragraph etc. will be required depending on availability of and access to such type equipment in the local institutions or university. A detailed list can be prepared during Year 1. The equipment will be purchased progressively over Years 2, 3 and 4.	Provisional allowance:	Year 2 Year 3 Year 4	100,000 100,000 100,000

General use

66.	Platform scales up to 50 kg	various	Year 2	1,000
67.	Platform scales up to 200 kg	various	Year 2	2,500

Application Development

68.	Provision for application development equipment and facilities (to be detailed later)	various	as required (allocate Year 2)	100,000

Equipment for administration and Technical Services

Library services

69.	Photocopier with reduction	various	Year 2	6,600
70.	Photographic equipment for production of fiches etc. and viewing apparatus	various	Year 2	4,000
71.	Computer terminal for data bank access and internal use, video monitor and interface units, printer	various	Year 2	35,000
72.	Books, journals, periodicals for library	various	Year 1 Year 2 Year 3 Year 4	10,000 25,000 25,000 20,000

General services

73.	Computer for accounts, stock control etc.	various	Year 3	35,000
74.	Photocopier	various	Year 2	5,000

75.	Office furniture and equipment (including typewriters, word processors, electronic calculators, telephones, switchboard, telex, desks, chairs, filing cabinets, bookshelves, carpets etc., library and conference furniture)	various	as required	50,000
	Engineering Services			
76.	Lathe, power drill, horizontal and vertical saws, electrical and mechanical tools and instruments		Year 2	30,000
77.	Equipment for drawing office		Year 2	6,000
	Technical services			
	Audio-visual equipment			
78.	35 mm automatic slide projector with QI light source and spares plus additional slide trays	Kodak	Year 2	800
79.	Tape recorder with electronic cueing equipment for automatic slide operation, with accessories and spares	various	Year 2	400
80.	Screen	various	Year 2	100
81.	16 mm sound movie projector and loudspeakers and spares	various	Year 3	1,000
82.	Epidiascope (projection hand drawn transparencies)	various	Year 2	700
83.	Microphones, amplifier and control unit loudspeakers accessories and spares	various	Year 2	800
84.	Loud-hailers (2)	various	Year 3	200
85.	Photographic facilities - darkroom equipment, 35 mm still camera, 16 mm movie camera, editing and lighting units, etc.	various	Year 2	1,500
86.	Colour-video camera, studio lights, tape recorders, microphones, video recording units, video editing unit, video cassettes and sound tapes and cassettes. Film to video recording equipment (3/4 inch tape for editing and transfer). Video monitor.		Year 2	42,000
	Transport unit			
87.	Project car	various	Year 1	12,000
88.	Project car	various	Year 2	12,000

89.	Project mini-bus for general use	various	Year 3	14,000
90.	Miscellaneous and contingencies		Year 2	20,000
			Total in US $	1,995,100

Delivery

Year 1	22,000
Year 2	1,243,100
Year 3	609,500
Year 4	120,500
Total in US $	1,995,100

Summary of Equipment Cost:

1.	Expendible equipment	Total in US dollars	84,000
2.	Non-expendible equipment	Total in US dollars	1,995,100
	Equipment	Total (in US dollars)	2,079,100

List of potential consultants

Some example descriptions of consultants are given to assist in setting out some of the possible potential needs. They will be made available to the project for short-term assignments. These are by way of example only and do not in any way restrict the nature of specialist expertise that may be required, for example, inclusion of training requirements, etc.

1. Consultant in extrusion technology

He should be a plastics technologist with production experience in blown film production, preferably covering both PVC and PE. He should have had development experience and with knowledge of extruders and instrumental control. He should also have had experience in pipe and profile extrusion with knowledge of the current take-off and pipe marking systems. Some experience of pipe installation would be advantageous. Previous experience of working in a developing country desirable. Language: English

2. Consultant in injection moulding

He should be a plastics technologist/engineer with experience of both hand operated and automatic equipment. He should be capable of training in machine setting, and have a knowledge of injection mould setting. He should have experience of the properties of polymers and be able to advise on fault finding and corrective technology. Previous experience of developing countries is advantageous. Language: English

3. Consultant in blow moulding

He should be a plastics technolgist/engineer with experience of both hand operated and automatic equipment. He should be capable of machine setting and able to advise on characteristics of suitable grades of raw material. He should be able to advise on fault finding and corrective technology. Knowledge of applications required. Previous experience of developing countries is advantageous. Language: English

4. Consultant in plastics fabrication

He should be a plastics technologist/engineer with practical experience of fabricating plastics products, by hand methods, from pipe, sheet and film. Experience of hot air welding of pipes and jointing, film sealing, pipe bending is required. He should be able to specify the type and quality of welding materials required, and of the different methods of fabrication.

He should have experience of FRP fabrication techniques and be able to design and prepare moulds, and make FRP mouldings. He should be able to advise on fault finding and corrective technology. Previous experience of developing countries desirable. Language: English

5. Consultant in analysis of plastics

He should be a chemist/technologist with in depth experience of both chemical and instrumental analysis of plastics, capable of undertaking investigational work on products which have failed in service and of advising on the nature of the changes which have taken place. He should be able to communicate his knowledge and discuss this subject freely. He should specifically have had experience in the analysis of PVC rigid and plasticized, LDPE, HDPE and PP.

6. Consultant in market research

He should be a graduate with experience of market research; previous experience of the plastics industry and its products would be advantageous. He should be able to investigate domestic, agricultural and industrial market areas for potential applications of plastics and to provide some assessment of the market size. He should be able to investigate the current applications of plastics and determine which would be suitable for development and how this could be accomplished. Previous experience of developing countries advantageous. Language: English

7. Consultant in testing of plastics

He should be a plastics technologist/testing engineer with experience of product testing. He should be capable of setting up test equipment and carrying out routine and special test programmes. Experience of interpretation of results obtained is essential and should be related to corrective technology. He should be able to sketch and advise on the making of simple test equipment like the dart-impact tester and demonstrate its use. He should have experience of quality control and how this can be applied in small scale industry. He should have experience of determing performance parameters and designing draft quality standards. Previous experience in developing countries essential. Language: English

8. Consultant in plastics formulation and compounding

He should be a plastics technologist with a wide range and in depth experience of the development of formulation of plastics compounds and preparation of compounds and master batches both at pilot plant and full scale production. He should be able to evaluate polymers and raw materials available locally and to use a Brabender Plastograph to interpret results of the compound formulations. He should be able to advise on the interpretation of the results in terms of formulation construction and modification.

It is essential that he has detailed experience of PVC compounds and in both rigid and plasticized grades. Experience is also required in formulations of additives of polyolefins. Experience of lecturing on this subject is desirable, as is previous experience in developing countries.

This consultancy will be on a split mission basis as required by the project.

9. Consultant in re-cycling of plastics

He should be a plastics technologist/engineer with previous experience of plastics compounding. He should have a knowledge of different re-cycling /re-processing systems for plastics, particularly those suited to a high-cost labour economy. He should be able to demonstrate re-cycling systems and have a detailed knowledge of the influence of recycled material on prime polymer. He should be able to formulate suitable compounds for specific applications. Language: English

10. Consultant in library and technical information services

He should be an experienced graduate librarian with specific experience in a library operating in the plastics industry. He should be able to prepare a list of titles to cover the immediate needs of the PTC in the fields of process and application development and testing. He should have a wide knowledge of the plastics technical journals available internationally and to advise on limited selections. He should be able to advise on the mechanics of establishing a technical information service. Language: English

11. Consultant in plastics in agriculture

A plasticulturalist of diploma or degree level with extensive experience and specialized knowledge in the use of plastics in agriculture. Knowledge of the different types of plastics, their processing characteristics and suitability for use in agricultural applications. Knowledge of the detailed agricultural requirements such as cultivation techniques, irrigation needs, storage requirements. Able to plan experimental and pilot demonstration trials to achieve economic application of plastics products and to determine the necessary work plan for this purpose.

12. Consultant in the use of plastics for water conservation

He should be a plasticulturalist expert with extensive experience in the use of plastics in agriculture co ering the latest developments, with knowledge of the processing of plastics and of cost effectiveness. He must have practical experience of the installation and use of plastics for agricultural reservoirs, canals and channels. Previous experience in developing countries would be desirable.

13. Consultant for intensive cultivation

He should be a plasticulturalist expert with extensive experience in the use of plastics in agriculture covering the latest developments, with knowledge of the processing of plastics and of cost effectiveness. He must have practical experience in the installation, design and use of tunnels and greenhouses covered with plastics film and of the cultivation of crops grown within such controlled environments. Previous experience in developing countries would be desirable.

WORK PLAN

BAR-CHART

ANNEX F

ACTIVITY	Year 1	Year 2	Year 3	Year 4
	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
1. Formation of Governing Board	—			
2. Appointment of Director	—			
3. Organizational Structure Development	—			
4. Appointment of key personnel and deputy director/and national staff	—	as required		
5. Prepare building plans	—			
6. Building and construction	—	—		
7. Preparation staff profiles	—	—		
8. Preparation annual budget	—	—	—	—
9. Familarization study tour - Director	—			
10. Provision advisory consultant to Director	— —	— —	— —	— —
11. Equipment specifications and ordering	—	—		
12. Overseas training		—	as required	—
13. Install equipment		—	—	—
14. Development of regional and international contacts		—	—	—
15. Study tours		—	as required	—
16. Provision of short-term consultants		—	as required	—
17. Sister institution arrangements		—	as required	—
18. Prepare development programmes and implementation		—	—	—
19. Preparation manuals-output profiles, etc.		—	—	—
20. Allocation management functions	—	—	—	—
21. Implement staff development programme	—	—	—	—
22. Information services activities		—	—	—
23. Marketing activities		—	—	—
24. Co-ordination with Regional Plastics Training Centre	—	—	—	—
25. Prepare and execute internal training programmes		—	—	—
26. Prepare and implement regional contacts with plastics industry		—	—	—
27. Preparation manual preventative maintenance		—	—	
28. Preparation physical resources document		—	—	—
29. Preparation of revenue sources document	—	—	—	—
30. Transfer of technology to users		—	—	—
31. Develop policy statement	—			
32. Annual reports and evaluation	—	—	—	—

Annex G

Job Descriptions of Key Personnel

1. Director of the Centre

A. Duties

1. He will be the executive Director of the Centre and will respond directly to the Governing Board. He will be responsible for achieving the objectives of the Centre and the specified outputs.
2. He will prepare and submit to the Governing Board for approval and then implement:
   a. A policy statement.
   b. A suitable organizational structure for the Centre, and modified from time to time.
   c. An outputs profile document.
   d. A comprehensive plan for the phased development of the Centre and reviewed annually.
   e. A financial plan for the Centre including budget, revenues sources with recommendations for the Board and up-dated annually.
   f. An annual report.
3. He will identify and develop the necessary management functions, objectives, and tasks which include policy-making, administrative and resource management, financial management, programme management, evaluation and forward planning, co-ordination and relations with the Governing Board, Government, other organizations and institutions, etc.
4. He will arrange for the preparation of the following:
   Technical manual
   Development manual
   Staff profile document
   Job descriptions
   Training schedules
   Physical resources document
   Revenues sources document
   Programme document of R + D and Application developments
   Sister-institutional agreement
   Co-operation agreement with RPDC (W)
   Transfer of technology developed by the Centre
   as part of the administrative development in the establishment of the Centre and take such actions as are necessary to ensure their implementation.
5. He will be responsible for the selection of 'key-staff' namely, the Deputy Director, the Head of Technology Division and the Head of Technical Service Division, and their appointment will be subject to the approval of the Governing Board. He will be responsible for the appointment of all other staff through the Deputy Director.

6. He will arrange for an evaluation to be made of the project.
7. He will submit an annual report to the Governing Board for their approval.
8. He will work with the Deputy Director as a close-team. He will take over the duties of the Deputy Director in his absence.

B. Qualifications

These have been broadly described within the project document. He should be a post-graduate engineer, chemical engineer or equivalent with at least ten years industrial experience in R and D operations or in technical service work, preferably in the plastics or polymer industry. He should have some administrative experience. More important is his personal committment, drive and personal ambition. He must be a natural leader.

C. Language

Arabic and English.

2. Deputy-Director of the Centre

A. Duties

1. He will be the Deputy-Director of the Centre and will respond directly to the Director. He will be primarily responsible for the administration activities of the Centre to enable it to meet the specified objectives and outputs, and for training activities.
2. He will be responsible for the planning, operation and effective functioning of the two sections under his direct control, Administration Section and Training Section, to meet the objectives set by the Director.
3. He will have special responsibility for the development and maintenance of an effective linkage with the RPDC (W).
4. Through the Administrative Section, he will arrange the establishment of the general administrative services necessary to ensure the smooth day to day operations of the Centre. These will include financial and accounts, personnel, purchasing, stock-control and stores, and such others as may be added by the Director when the final organizational structure of the Centre has been finalized.
5. With the co-operation and assistance of the Heads of Divisions he will prepare for submission to the Director the following:

   Staff profile document for personnel required by the Centre for its activities
   Detailed job descriptions
   Recruitment and appointment of Section Leaders
   Allocation of staff
   Staff induction and training system and schedules
   Staff development and assessment scheme.

In co-operation with the Heads of Division, when necessary, he will be responsible for the recruitment and appointment of all other personnel.

6. In co-operation with the Heads of Division he will be responsible for the placement of trainees either from RPDC (W) or from industry or other organizations within the Centre, and for the development of their training programmes and final assessments.
7. In co-operation with the accountant in charge of financial services etc. and Heads of Divisions he will be responsible for the preparation of
   physical resources document
   revenue sources document
   monthly and annual budget forecast
   for submission to the Director.
8. In co-operation with the Head of Technical Services he will prepare and establish a system of inventory and stock-control for the Engineering stores and ensure its implementation through the Head of Technical Services Division.
9. The preparation of a long term plan for the development of his Sections in consultation with the Director and in accordance with the policy statement approved by the Government Board. This will be reviewed annually and updated.
10. In co-operation with the Director, will prepare a financial plan for the Centre indicating budget estimates, revenue sources with recommentations for the Board and updated and reviewed annually.
11. For the financial management of the Centre in co-operation with the Director.
12. Ensuring that the necessary administrative manuals for the operating of the administrative section are made available by the host organization and implemented.
13. The submission to the Director of an annual report relating to the activities of his two sections.
14. A periodic statement of accounts to the Director at periods to be determined.
15. He will work with the Director as a close team. He will act as Director in the absence of the Director.
16. Any other actions which may be required to ensure that his Sections fully meet all its obligations to achieve the objectives of the Centre and outputs specified.

B. Qualifications

He should be a graduate (or higher) in commerce or administration, or equivalent. He will have at least 8 years practical experience in administrative position, either in industry, institution or Government. He needs to show leadership and an excellent ability to work with other people. Experience in training operations would be desirable. He must be an excellent organizor and with a full understanding of management systems and control.

C. Language

Arabic and English.

3. Head of Technology Division

A. Duties

1. The Head of the Technology Division will be directly responsible to the Director in all technical matters, and will be responsible to the Deputy Director in matters of administration and of training relating to his Division.

   He will be responsible for:

2. the planning, operation and effective functioning of the three sections under his direct control - Investigations and Testing Section, Process Technology Section and Application Development Section - to achieve the objectives set by the Director.
3. the preparation of a manual detailing the methodology to be adopted for the design, implementation, assessment and evaluation of R and D programmes and the dissemination of results. In the transfer of technology developed will include the mechanisms to be utilized through the facilities of the Technical Service Division to ensure the results are made known to both existing and potential users. After approval of the manual by the Director, and by the Governing Board, he will implement it.
4. the analysis of requests and development of R and D programmes, and investigations, to be undertaken by the Sections.
5. the development of multi-disciplinary teams, when necessary for specific programmes, by drawing on the total personnel resources available within both Divisions through co-operation with the Head of Technical Services Division.
6. the development and maintenance of co-operative links with other related institutions (including Universities) in the region, as well as with the overseas sister institution for development of technology and services.

7. the development and maintenance of special links with the RPDC (W) to ensure a two-way regular flow of information and services.
8. the preparation of a staff profile document, in co-operation with the Deputy Director, for the personnel requirement of his Division. He will determine a plan for their training requirement and be responsible for its execution and assist in a programme of staff assessment in co-operation with the Deputy Director.
9. the preparation of a long-term plan for the development of his Division, in consultation with the Director, and in accordance with the Policy statement approved by the Governing Board. This will be submitted for inclusion in the plan to be prepared by the Director for submission to, and approval of the Governing Board.
10. broadening the range of experience of his Section Leaders by exchanging their responsibilities, from time to time.
11. the development and maintenance of regular links with raw material suppliers, machinery suppliers and manufacturers, and with Plastics Trade Associations.
12. making a request for short-term consultants, in consultation with the Director, for specialized assistance as and when required.
13. the development and maintenance of regular links with organizations responsible for development of Standards and test methods for plastics and the sharing of services and facilities.
14. the preparation and submission of periodic reports to the Director, and Deputy Director at intervals to be determined.
15. the preparation and submission of an annual report, together with annual budget estimates.
16. any other actions which may be required to ensure that the Division fully meets all its obligations to achieve the objectives of the Centre and the outputs specified.

B. Qualifications

A graduate or post-graduate chemical-engineer, engineer, plastics technologist or equivalent with at least 6 years experience in plastics processing or testing in either R and D or in industrial operations. He should have some managerial experience. He needs to demonstrate an enquiring mind, natural leadership and an ability to work with others. He must believe in plastics as a material with a future.

C. Language

Arabic and English.

4. Head of Technical Services

A. Duties

1. The Head of Technical Services will be directly responsible to the Director in all technical matters, and will be responsible to the Deputy Director in matters of administration and of training relating to his Division. He will be responsible for:
2. the planning, operation and effective functioning of the three sections under his direct control - Engineering, Information Services, Communication Services - to achieve the objectives set by the Director.
3. the preparation of a manual of routine preventative maintenance.
4. the preparation, execution and checking of maintenance programmes.
5. assisting the Deputy Director in the preparation of a manual of physical resources of the Centre.
6. the collection, in consultation with and co-operation of the Head of Technology Division, and indexing of all service and operational manuals issued with all equipment and machinery received and installed at the Centre.
7. establishing, in conjunction with the Deputy Director, a system of inventory and stock control for the Engineer stores.
8. assist and co-operate with the Head of Technology Division to establish multi-disciplinary teams, when necessary, drawing on the total personnel resources available within both Divisions.
9. initiate and develop regular discussion group meetings with appropriate Governmental Ministries or related institutions, including members from Application Development Section.
10. identifying new areas for adaptive technology programmes, and their subsequent development and evaluation by Technology Division (including plastics in agriculture and industrial applications).
11. promote the formation of discussion graoups within the regional plastics industry.
12. in co-operation with the Head of Technology Division, to plan and arrange all meetings, conferences etc. involving outside bodies/organizations etc. whether on an individual basis or as part of co-operative or special links developed by the Technology Division.
13. the preparation of a staff profile document, in co-operation with the Deputy Director, for the personnel requirements of his Division. He will determine a plan for this training requirement and be responsible for its execution, and assist in a programme of staff assessment in co-operation with the Deputy Director.

14. the prepraration of a long-term plan for the Development of his Division, in consultation with the Director and in accordance with the Policy statement approved by the Governing Board. This will be submitted for inclusion in the plan to be prepared by the Director for submission to and approval of the Governing Board.
15. broadening the range of experience of his Section Leaders by inter-changing their responsibilities from time to time.
16. in co-operation with the Head of Technology Division, will arrange the collection and publishing of technical information for inclusion in Technical Information publications of the Centre, and such other publications and promotional activities which may be required in the promotion of the work of the Centre to meet its objectives.
17. initiate and develop co-operative technology meetings with the mould-design and mould-making organizations in Algeria and in Iraq, and such other companies as may come into existence.
18. initiate and negogiate, with the approval of the Director, such sub-contracts as are required to provide facilities and services to enable the Centre to meet its objectives.
19. filing and specifying patent applications based on the work of the Centre at the request of the Director.
20. providing and arranging the transport requirements of the Centre.
21. providing and executing marketing studies, the collection, indexing and retrieval of technical information and statistics as a service both within the Centre and to requests from outside bodies.
22. making requests for short-term consultants, in consultation with the Director, for specialized assistance as and when required.
23. any other actions which may be required to ensure that his Divisions fully meet all its obligations to achieve the objectives of the Centre and the outputs specified.
24. preparation and submission of periodic reports to the Director, and Deputy Director at intervals to be determined.
25. preparation and submission of an annual report, together with annual budget estimates.

B. Qualifications

A graduate or post-graduate chemical engineer, engineer, chemist, information specialist, or plastics technologist with at least 6 years experience in industry, preferably in the plastics industry, either in R + D, in technical service, or information service activities. He should have some managerial experience. He needs to demonstrate an enquiring mind, natural leadership and an excellent ability to work and co-operate with personnel at all levels. He must believe in plastics as a material with a future.

C. Language

Arabic and English.

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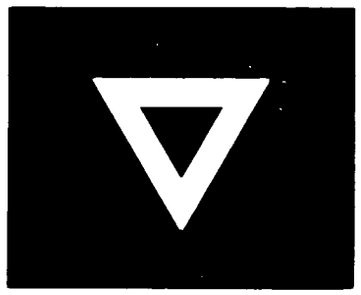

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