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MASTER PLAN FOR THE DEVELOPMENT OF NATIONAL RESEARCH INSTITUTIONS
AND THEIR CONTRIBUTION TO THE DEVELOPMENT
OF THE INDUSTRY

UC/IRA/93/032/11-01

ISLAMIC REPUBLIC OF IRAN

Terminal report*

Prepared for the Government of the Islamic Republic of Iran
by the United Nations Industrial Development Organization

Based on the work of F. Kovats, team leader
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* This document has not been edited.

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EXPLANATORY NOTES/ABBREVIATIONS

Currency: Rial (IR), or (Rls) IR10= 1 toman

On March 21, 1993, the Government abolished the old official rate (IR 70=\$1) and the competitive rate (IR 600=\$1).

At the time of the present mission (April-June 1994) the Government managed exchange rate was: IR 1750=\$1, while on the free market (available for private persons and also for private enterprises) IR 2400-2700=\$1.

\$: US Dollar

tons: metric tons

finished or formulated products are pharmaceutical products or pesticides ready for use, made from active substances and additives

raw materials are used to produce intermediates to prepare active substances which have the desirable effect

additives auxiliary materials added finally to the active substance by the formulation in order to modify/enhance the effects (diluent, carriers, surface active agents, etc.)

Abbreviations:

ECO	Economic Cooperation Organization
FDPPC	Fertilizer Distribution and Pesticide Production Company
IBB	Institute of Biochemistry and Biophysics
IROST	Iranian Research Organization for Science and Technology
ISIRI	Institute of Standards and Industrial Research of Iran
MO	Ministry of Oil
MOA	Ministry of Agriculture
MOE	Ministry of Education
MOH	Ministry of Health Treatment and Medical Education
MOI	Ministry of Industry
MOJ	Ministry of Jihad Sazandegi = Ministry of Construction Crusade
NIIO	National Iranian Industrial Organization
NPC	National Petrochemical Company
NPD	National Project Director = Dr. A. Tofigh Deputy Minister of Industry
PPDR	Plant Pests and Diseases Research Institute
PPO	Plant Protection & Quarantine Organization
PRCI	Polymer Research Center of Iran
R&D	Research and Development
GMP	Good Manufacturing Practice
GLP	Good Laboratory Practice
GCP	Good Clinical Practice
[]	Reference to expert reports

ABSTRACT

Title and number of project: UC/IRA/93/032 Master Plan for the Development of National Research Institutions and their contribution to development of the industry.

Objectives: The project intends to upgrade the technological base of the country by the research institutes to important sectors.

Purpose of the mission: To provide advice and assistance to the Government of the Islamic Republic of Iran in assessing the present R&D institutions working in the country and the development capabilities of these institutions to contribute to the improvement of the related industrial sectors.

Duration of the mission: 4 April - 3 July, 1994.

Activities: The mission has been accomplished by a team of eight experts, working in the following fields of industry (except the oil industry): food and agrochemical; marine products, petrochemical, plastic and resins, fine chemical and pharmaceutical, building materials, mineral resources, renewable sources of energy.

The international experts had the opportunity to get acquainted with 67 institutions (R&D institutes, private research centers, factories, governmental and international organizations), made altogether 88 visits, (for the Iranian members of the team no special visit was necessary during the mission, however they contributed to the team work by escorting foreign team members to important places).

SUMMARY OF FINDINGS AND RECOMMENDATIONS:

The Islamic Republic of Iran is a country rich in natural resources and has a developing petrochemical industry. However minerals (except oil and gas) and agricultural products are far less exploited than needed. A number of highly educated specialists - graduated at renowned foreign universities - are available. The main constraints in the development of the economy are the following:

- high growth rate of population (3.28 per cent annually)
- limitations in foreign currency
- isolation from world market, poor access to modern technologies, processes, results
- inadequate utilization of results of national scientific institutions
- poor (if any) interaction between research and market
- poor flow of information, access to updated data is very difficult
- subsidized, low prices for industrial products hinder the economic justification of R&D projects.

INTRODUCTION

The Government of the Islamic Republic of Iran has recognized the need for rehabilitation of the industrial sector and has undertaken high priority actions to upgrade the technological base and to replace the obsolete technology, particularly in the industrial sector.

The First Five Year Plan set a growth target of 14 per cent per annum during the period 1989-1993 in the industrial output and a several fold increase in non-oil exports.

In order to achieve these targets, technical assistance may be required to prepare a programme to update the technology of the industrial sector. For this, it is envisaged that the activities of the Iranian research institutions should be geared to assess and update the technological needs of the Iranian industry.

The Ministry of Industry (MOI) intends to implement a national plan to establish a linkage between the programmes of the research institutions and the existing industries, to upgrade ageing technology, ensure improved production and commercialization of the research findings. This will also increase export and encourage private sector entrepreneurs to invest in industries.

In 1992, during the last official mission of the Director General of UNIDO to Teheran, UNIDO was requested to assist the MOI to provide highly qualified advisory assistance to develop a framework to facilitate establishing a linkage between the work programme of the research institutes and the requirements of industries.

Initiated by the above mentioned activities, the implementation of the project: "Master Plan for the development of national research institutions and their contribution to the development of the industry" has been agreed upon by UNIDO, UNDP and the Iranian Government.

The project addresses the scope of activities for a group of sectors selected by the Iranian counterpart which are of vital importance for the improvement of industrial production in the country.

At the opening discussions, the Iranian counterpart unfolded its request to receive useful and usable answers to the following questions formulated by the NPD:

1. *What mechanisms could be recommended to link the research and development centres with the Iranian industries and vice versa?*
2. *How can the findings and results of the research works be commercialized?*
3. *What are the present capabilities of research centres? What new research projects can be performed?*
4. *How can MOI involve the national researchers in definition of the development strategy of the country (not just to do research)?*

The direct beneficiaries of the project will be the medium and small-scale industries who urgently need to upgrade their ageing technology. On the other hand, the research institutes will also develop a direct link with the industries which will enable them to orient their programme to suit the development efforts of the country.

The programme will also attract the interest of private entrepreneurs who are expected to invest in the industrial sector with the development of new technologies and product lines.

The immediate objective of the project is to facilitate the MOI to establish a mechanism to link the activities of the research institutes to the needs of the related industrial enterprises.

The project has been based on a three-month mission of eight experts to Iran. The experts, in general, have each spent one month visiting institutions (research institutes, universities, private research centers, factories, fisheries, governmental and international organizations). The team leader and the two Iranian members were assigned for the complete duration of the mission to prepare the programme and organize the visits of all members in addition to carrying out their own expert activities.

All the experts have prepared their technical reports complying with UNIDO's requirements and containing their findings, recommendations, summary of company visits and references. Eight technical reports have been issued separately and belong to the present terminal report.

The terminal report of the project is based on the technical reports of the international experts and contains the main elements of their findings and recommendations extracted by the NPD and the team leader. References to the specific experts reports are signed by [name of the expert]. List of technical reports prepared under the project:

1. Technical report of Mr. BUCHER Wolfhardt (for renewable sources of energy)
2. Technical report of Mr. IVANUS Gheorghe (for petrochemical industry)
3. Technical report of Mr. KAMINSKI Edward (for food and agrochemicals)
4. Technical report of Mr. KOVATS Ferenc (for fine chemical and pharmaceutical ind.)
5. Technical report of Mr. MIRMOHAMMADI Ali (new and building materials)
6. Technical report of Mr. MISTEREK Bogouslav (plastics and resins)
7. Technical report of Mr. OLIAZADEH Manoucher (mineral resources)
8. Technical report of Mr. TERUEL Hector (marine products)

I. ACTIVITIES

Time frame of mission

The duration of the mission was 3 months, from 4 April - 3 July 1994. The timing of the visits of the experts, together with the report on their activities, can be found in their individual technical reports.

Starting-up activities

The mission started with meetings with counterparts headed by the NPD. After the necessary briefing, the time schedule of the mission was set up. Appointments for visits for the first two weeks were fixed. Regular weekly meetings of the team had been decided

- for mutual information of team members;
- to evaluate and discuss performed visits and
- to prepare visits and activities of the next week.

A newly installed office equipped with telephone, fax and personal computer was put at the disposal of the experts. At the request of UNIDO, the programme WORD PERFECT had been installed in the computer.

Accommodation of all experts in the same building made daily discussions and evaluations possible which proved useful for the mission.

Visits to companies

During the mission, 88 visits were made to 67 different organizations (research institutes, universities, private research institutes, factories, governmental and international organizations). The visited companies, selected by Iranian counterparts, represent a cross section of the industrial sectors related to the mission (large "homogenous" research institutes, medium size and small private research centers, industrial companies and factories of various sizes) and contributed to the orientation and acquisition of general and detailed information for the experts within a short time.

Visits to central authorities and international organizations.

For basic information the relevant ministries were also visited. Information on cooperation with international organizations had been collected from FAO and WHO.

II. GENERAL OVERVIEW

To bridge the distance between research and practice represents one of the biggest problems all over the civilized world. Governments of both highly developed and also less advanced countries face the difficulty; problems vary from country to country, and no uniform solution can be recommended.

However, some general aspects of the problem may be summarized: One of the main obstacles to disseminating R&D results is the poor flow of information from R&D to "practice" (potential consumers, such as industry, agriculture, market) and reversely, from "practice" to R&D

The importance of this cross information between sectors of industry, agriculture and other parts of the national economy cannot be overemphasized, its absence may be the most significant constraint in the development of national economies.

Priorities of the country should also be taken into consideration. The implementation is the task of the government. The role of the central authorities can be rather complex, depending on the structure of the given country. It can (or must) include:

- control
 - financial
 - organizational
- information
 - supplying
 - acquiring
- managing
- assistance, subsidizing

In order to be simple the model contains only one authority (the government).

In reality the government is exercising its duty through many of its branches (ministries, offices etc.), which have independent authorities in their field.

In addition to that there are the other institutions having national competence, so the real situation is even more complex. It has to be taken into consideration that all processes in the economy are mainly *spontaneous* (i.e. governed by the laws of the market), while the interactions with authorities are *deliberate*.

Following our interest in the possibilities of controlling R&D results, let us make a short survey of the various types of respective organizations and their characters in the country.

III. SUMMARY OF FINDINGS

Population

The average annual growth rate of the population of the Islamic Republic of Iran is 3.28 per cent. The importance of this figure may be interpreted and realized by some facts and projections:

Population in year	1960	1994	2000	2020
millions	20	60	80	110

Such an increase rate makes it extremely difficult to fulfil the socio-economic plans of the country.

Situation of development of the industry

The various branches of Iranian industry have developed unevenly in the past, with many missing links in between. This means they are not capable of meeting requirements of other industrial branches. (Dependence on import: 56.7 per cent; chemical sector: 71.1 per cent; food: 29.1 per cent.)

The absence of a model of industrial development in the post-revolution years has impeded the framing of a clear-cut industrial policy. In various fields of the economy efforts have been made to transfer the national targets (mainly those of the Five Year Plans) to sectoral levels, seemingly ignoring the fact that the desired changes would only be enduring and really useful in an institutionalized economic system.

The results could be felt in all sectors on all levels:

- lack of contact/information between R&D and industry and between industrial sectors;
- lack of personal/institutional financial interest in outputs;
- conflict of interest between sectors, between state and institutions, between employees and company, and between consumers and producers.

The solution may have structural, organizational, and economic components. The experts tried to offer some in their recommendations.

Technological environment

Utilization of results of science (let it be basic or applied research) in a country is dependent on several factors. A detailed analysis is out of scope of the present report, but the main important issues are briefly summarized:

- national concept for development, based on sectoral programmes-subsectoral targets;
- governmental control on R&D activities;
- governmental support/protection (duty-tax policy) for new indigenous products;
- producers interest in product/process development;
- usable results of (esp. applied) research;
- flow of reciprocal information between market (producers) and research institute;
- institutional/individual (financial) incentives/interest;
- effective patent legislation;
- properly educated staff;
- traditions (industrial and cultural).

The coefficient of the above components is manifested in the "technological environment" or "innovation (un)friendly atmosphere" and by the "diffusion" of R&D results in practice.

Investigating these components individually, the findings of the experts can be summarized as follows:

- during the mission, experts could not encounter a centrally formulated research plan (concept) broken down to industrial sectors;
- the Government of the Islamic Republic of Iran has recognized the importance of developing the industry and is searching for new ways to enhance it (the present project has the objective to help this activity);
- due to the extreme shortage in foreign currency, there is no real competition between imported and locally manufactured products, consequently:
 - no need (in general) of governmental support in tax-duty policy; and
 - producers enjoy this "greenhouse effect" without any central policy, so their interest in new developments is extremely limited (which, in some cases, also has a damaging effect on the quality);
- the flow of information between market (producers) and research institutes is poor and the same is valid for the interactions between various sectors of science and the

economy: all participants of the national economy are suffering because of the lack of (even domestic) information;

- institutions and/or individuals are not interested in the outcome (future utilization) of their work (except some R&D units in factories);
- patent legislation is not complying with international practices;
- all the above situation is in the presence of a number of highly qualified specialists in all parts and sectors of the industry.

The above observations represent a general summary, however, there are numerous exceptions - the application-oriented successful research in IROST, or the keen interest of pharmaceutical companies (and cosmetic industry) in new developments, or extreme flexibility and market-oriented R&D activity of the private research centers, or the implementation of big petrochemical complexes - to name only a few. These exceptions, together with the ambition of skilled experts in the various sectors, and the strong decision of the Government yield the base for hope to create favourable conditions for innovation in the near future.

After these general observations, a closer view of the R&D life is worth attention.

Research and Development Institutions

Organizations active in the R&D field in Iran can be classified into three groups:

1. Government-owned research centers and "homogeneous" research institutes
2. R&D units of factories
3. private research centers

1. Homogeneous Research Institutes

(Engineering Services and Research Companies of Homogeneous Industries)

Beside the Government-owned research centers, there are 15 well staffed and equipped institutes under the supervision of MOI, or MOE directly or indirectly owned by the state, with the aim to satisfy the demands of a concrete industry (with the exception of the fine chemical-pharmaceutical sector, which has none). These institutes differ from each other, due to the characteristics of the sector they "serve".

Some of them do also basic research, some are oriented mainly toward applicable results. The contacts with factories could be more fruitful, in case:

- factories were more *market-oriented* and asking for research resulting in *new products* requested by the market, or useful *new processes*; and
- if the institutes concentrated more on directly *applicable results*, than on research for itself.

In addition to those, a more open attitude towards other sectors, participating in interdisciplinary projects, even cooperation with end users from outside of the "homogeneous" field, a better utilization of available expertise-instruments-personnel, may also be taken into consideration.

As a good example, the application-oriented research concept of IROST should be mentioned. This institute is concentrating on the utilization of its results: one of the basic priorities is the pilot scale development. Among the projects there are some requesting international attention, especially the anti-malaria vector research because of its potential use in several developing countries, and the conversion of Diesel engines into gas operation, reducing the air pollution and improving the economy of fuel consumption of automobiles.

Constraints: Insufficient information on recent scientific results in the world (books, periodicals, on-line access to data banks);

Poor (if any) background for maintenance/spare parts and reference material for high performance analytical instruments.

2. R&D units of factories

Among the companies supervised by the MOI there are 172 having their own R&D unit. MOI makes efforts to urge organization of R&D units in companies having more than 250 employees. The main fields of activities of these units are:

- global orientation in new results, products, processes (in close cooperation with the marketing department);
- development of new products;
- elaboration of more economical processes;
- technological development to comply to environmental prescriptions;
- contribution to quality control, analytical support;
- assistance in trouble shooting.

The forerunner in this domain is certainly the pharmaceutical sector, with each company having its own R&D unit, fairly equipped with up-to-date process machinery enabling them to stand international competition in new dosage forms. The Research Center of Darou Pakhsh Co. is able to carry out fully integrated pharmaceutical research for the registration of new drugs: i.e. from the synthesis of new molecules, through the necessary chemical and biological screenings including pharmacology, toxicology and finally the human test in clinics with the final dosage forms.

3. Private research centers

The department of the Deputy Minister for Research and Training, with due consideration to the policies of the Ministry of Industries for the advancement of the targets of the first economic, social & cultural plan in the industry sector and to lay the foundation for an industrial research system and dissemination of applied and developing research in the country, has undertaken different fields of activities with a view to strengthening the relations between the researchers and the industrialists in solving the problems of the industries and thus leading to self sufficiency.

Two important factors for expansion of industrial research activities are suitable organization & the required formations. Global experience shows that in order to organize an industrial research system, it is essential to establish a chain of research units and to take advantage of the expertise and finances of the private sector. This recognition led 12 years ago the concept of the Private Research Centers introduced by Deputy Minister Dr.A. Tofigh.

Till now 139 licences have been issued, 64 units are already working.

Their distribution among sectors is as follows:

Chemical, pharmaceutical, cosmetic industry	50
Electric & electronic	26
Food	14
Non metallic	12
Metallic	11
Environmental protection	9
Medical engineering	2
Lignocellulose	2
Textile & clothing	<u>1</u>
Total:	139

Foundation of these units has been initiated more or less spontaneously by the (supposed) demands of the market, consequently the above numbers, the ratio of them, moreover the lacking (for example: pesticides, techno-economical enterprises (preparing feasibility calculations and planning), agricultural equipment (esp. for small holders), architect bureaus, inner architects, furniture,

planning and manufacturing of kitchen-hygienic equipment etc.) require the attention of the Government.

Working methods of these enterprises show wide (and sometimes wild) variety. The number of employees is 5-50, with graduated experts about 2-10.

The Head (in most cases {one of} the owner{s}) is a scientist or specialist with good reputation and having also broad industrial expertise.

Their activity can hardly be characterized by usual definitions. They do "everything " which is needed: from applied research through product and/or process development to production, including sometimes the marketing functions as well. The acquisition of new projects need not be mentioned.

Scaling up of laboratory results is done simultaneously with market research and starting regular production is frequently also realized on the pilot scale equipment - until the final production facility is completed.

The lack of "big" instruments (needed mainly for analytical investigations) can be solved by cooperation with the homogenous research institutes, or with universities.

The private research centers may be good partners of the big factories.

Flexibility, short reaction time, ability for small production series/batches may be extremely useful, specially during the introduction period of new products, or penetration into new markets.

This activity resulted (among others) in the utilization of indigenous raw materials (even wastes) for example paraffin from the petrochemical industry for various uses, or tallow from slaughter houses for cosmetics.

Constraints of private research centers should also be mentioned: poor equipment, combined with haste in working may increase risk in working safety and may lead to environmental hazards; poor access to recent foreign scientific results, including literature; and last but not least: steadily decreasing, but still strong, limitations in foreign currency and capital investment.

So the role of the Government after the initial foundation period may be characterized:

- removing (or decreasing) the above mentioned constraints;
- enhancing contacts, joint venture with foreign companies;
- creating favourable conditions for foreign investors;

- financial backing up (tax, duty) of domestic innovations/products;
- indicating and sponsoring of projects having national priority;
- monitoring the results and activity of private research centers; and
- promoting the dissemination of their results.
- use their skill and expertise for the evaluation of teachers, selection of new equipment.

Summarizing all the above mentioned:

Due to their skill, sensitiveness for innovation, enthusiasm and not least their profit orientation, private research centers serve as the "light cavalry", they can not (do not want to) replace the heavy armoured big corps of the army, but used for reconnaissance and surprise attack they can complement the activity of bigger units.

By their activity, the Government of the Islamic Republic of Iran seems to have made a successful attempt to combine central state influence with the spontaneous forces of the market, a method already proved to be useful in developed countries.

Planning and Management of R&D, Flow of Information

During their visits in Iran, the experts could not encounter a centrally formulated research plan (concept) broken down to industrial sectors. The various ministries and/or organizations having national competence elaborate their own plans, set up their targets trying to realize the general decisions of the Government.

The lack of a coherent R&D plan for the whole national economy, broken down to industrial sectors (taking into consideration the needs of other sectors as well) is badly needed.

Management of R&D projects should be improved, using more advanced methods (inc. personal computers), but the most important factor would be the personal competency (authority linked with responsibility, product oriented salary system)

The delegation of authority (together with responsibility) to the proper (lower) level would liberate heads of departments from unnecessary details of daily administrative burdens and let them concentrate on their essential tasks. The distinction between order (used in the armed forces) and management (practised by disciplined, independent, responsible civilian individuals) should be borne in mind. Competence of managers, programme officers must be clearly formulated and separated from higher and lower levels. Duplications, overlaps, ambiguities should be avoided.

Patent Situation

A general experience during the mission has been that no proper attention is attributed to questions related to patents. Not going into details of the patent law and practice in Iran (being outside the scope of the present mission) a general observation however cannot be avoided.

Cooperation concerning acquisition of processes of new products, buying licences, know-how, can be realized only if the patent legislation of the country is complying with international practice.

On the other hand, results of Iranian research cannot be commercialized with success without proper patent protection.

IV. SUMMARY OF RECOMMENDATIONS

In order to satisfy the requirements of the Iranian counterpart concerning the answers to the questions (quoted in the chapter : Introduction), experts have made recommendations not only related to their sector but more or less valid for the Iranian industry as well. So recommendations of the experts may be classified into two groups:

- general recommendations and
- sectoral recommendations.

GENERAL RECOMMENDATIONS

1. R&D Planning

1.1 Coherent development plan for the whole economy, broken down to industrial sectors should be prepared. Coherent means, the plan has to take into consideration the reciprocal needs/supplies/services between the various sectors of economy. The plan should have two parts:

- strategic national concepts, and
- sectoral elements

The plan should be prepared by iterations i.e. the first draft of concept summarizing the strategic tasks/long term targets of the Iranian economy should be given to the sectors to set up their targets in their sectoral plans; these sectoral plans should be fed back to modify parts of the original concept. Then as a second iteration the plan should be presented for public discussion and criticism, especially to private companies and experts of high reputation. After collecting the remarks and proposals, the final plan should be prepared and permanently adjusted to actual demands.

1.2. Assessment of R&D capabilities and needs of industry. In order to have proper orientation and also as part of the national development plan (1.1), an analysis should be made on the R&D capabilities related to the following main issues:

- on-going and planned R&D programmes and projects in research institutes,
- intercommunication between ministries,
- R&D in private sector,
- on-going and planned projects of industrial companies,
- comparison with international data,
- market demands, etc.

2. Organization

2.1 Ministry of Research and Development

All experts raised the question of a separate ministry. The discussion in detail exceeds the frames of the present study. However it can be mentioned that coordination and control of R&D activities in a country of Iran's size, complexity of economy, development possibilities and natural resources will make it necessary to establish a ministry to deal properly with the problem.

2.2 Bridge organizations

R&D activities by their nature are going on in various fields of science and are also divided among sectors of the economy. Direction and guidance of R&D by government is realized by so called bridge organizations in many countries. Even countries having ministry for R&D utilize this practice. The main task is to link various sectors of the economy/industry, and also realize a closer contact between R&D and production. Especially the German Fraunhofer Society, or the French ANVAR (International Agency for Utilization of Research), or the Japan KTC (Top Technological Center) could be recommended for closer study. The best way would be personal visit and change of experience on the spot by Iranian top officials.

2.3 Agency for the development of information

The direction of their activity should be both horizontal (connecting various sectors) and also vertical (linking research, development, production, sales, market) [Kovats]

2.4 Supervision of the structure/activity of research institutes

In order to be more useful and flexible, the present structure and working methods of the big research institutes need supervision. [Bucher, Ivanus]. A better integration of R&D in the industrial activities seems to be inevitable.

3. Financial support of R&D

3.1 Sponsoring system

R&D projects are and will always be sponsored fully or partly by the state. The financial support may have different forms:

- full support without repayment (national priorities)
- full support with repayment
- in equal parts in time, after the project has been finished
- only from profit of the project (risk taken by the state)
- repayment in form of royalty
- partial support, with or without repayment

3.2 Public tenders for support

All funds should be available through public tenders. The evaluation should be made by independent (if necessary foreign) experts.

3.3 Contract research for industry

Research institutes should be pressed by government to gradually shift their activity and income plan towards contracts with factories for solving actual problems.

3.4 Individual incentives

Participants of successful R&D projects should be remunerated.

4. Economical support

4.1 Reassessment of pricing/subsidizing system

The issue, by its nature, is outside the scope of the present study. However, artificially and extremely low prices may be (and are in Iran) obstacle of the development. The present price levels of gas and oil, are just a few examples which kill the feasibility of new energy saving projects, or make the use of renewable sources of energy questionable. Low prices do not allow for companies to spend adequate funds for new products and to improve quality. Instead of being given to producers, the same amount of subsidy should be distributed to deserving families according to their social surroundings. Such changes in the subsidizing system have immense socio-political consequences. The scope of the present mission is limited to development issues, but for the future development of the Iranian economy a carefully prepared and executed change in the subsidizing system is recommended for consideration.

4.2 Support of new products/replacements of imports

Protective tax-duty policy for home made products, tax exemption for raw materials used for replacement of imported goods should be considered. Commercialization of R&D results may be enhanced if

- the end point of the research should not be the final report, but the industrial application, and
- the institute should get royalty from the revenue, and
- staff members, who contributed to the implementation of the project both in the factory and in the institute should also participate in the recompensation.

5. Market

5.1 Self-sufficiency

Considering the existing natural resources of the country the first priority above question is the gradual replacement of imports. Especially the pharmaceutical, mineral, and chemical industries yield possibilities. (See: the following sectoral recommendations and [Kovats, Oliazadeh])

5.2 Regional market study

Iran has a favourable position to be a leader in the regional market of the neighbouring countries, first of all in the newly established republics. A detailed market analysis seems to be the next step especially for the food and pharmaceutical-chemical-cosmetic products. (UNIDO, WHO, ECO may be also involved)

5.3 Privatization

The Iranian Government has started a procedure in frame of which the ownership of industrial enterprises is going to be taken out of the direct control of ministries. Also the private sector is going to establish new ventures. The results are already obvious: former state owned companies are going to be more flexible, they operate as private enterprises. The most successful example are the private research centers. They unite the whole process of R&D with production and marketing. The continuation of the process of privatization especially with more access to foreign currency (first of all for those who can earn it by exports) is strongly recommended.

6. Patent system

In order to meet the demands of the development of certain industries (first of all the pharmaceutical, electronics) revision of the present patent legislation seems to be inevitable. No achievements of science and technology could be acquired unless complying with internationally accepted practice. Also results of the Iranian research can be commercialized much better and more successfully in foreign markets by proper patent protection.

7. Education

In the implementation of the national development plan one of the (if not the) most important issue is the professional education. Especially the R&D management, preparation of investment documents (feasibility studies etc.) marketing, information systems need special staff to be educated through various forms. (Regular seminars, workshops, training courses etc.)

8. Task force for the implementation of the present recommendations

If the above summarized general suggestions and the following sectoral recommendations are really applicable (which of course has been the main ambition of the experts) the most important question is the follow up of the mission, i.e. its implementation. Consequently the final recommendation is to set up a task force to:

- evaluate the reports,
- set up priorities and
- find modalities with time schedule for the implementation.

SECTORAL RECOMMENDATIONS

The following list has been prepared to draw the attention to the most significant recommendations made by experts. Details of the suggestions and other proposal having less importance for the whole economy can be found in the respective reports.

Minerals-building industry:

- prospective study/programme to find new deposits
- testing of the ore amenability for dressing processes
- pilot plant for the mineral industry

Pharmaceutical-fine chemical industry:

- development plan for the pharmaceutical industry based on marketing data (domestic and regional markets)
- environmental protection and self sufficiency
- import replacement of pharmaceutical active substances
- import replacements of pesticide active substances
- Shahid Modarres project Phase II.
- production of veterinary pharmaceuticals (Razi Institute)
- homogeneous research institute for the pharmaceutical industry

Biotechnology and Genetic Engineering:

- studies for establishment of a natural/regional centre on biotechnology and Genetic engineering
- definition of main fields of R&D

Renewable sources of energy:

- working group for the assessment of the implementation of R.E.
- significance of R.E. in remote places (villages) not connected to electrical supply

Food industry:

- cooling of milk to 4 centigrade immediately after milking
- flour & rice Vitamin B1
 - restoration in flour
 - parboiling of rice
- hazards analysis critical control points (HACCP)

Petrochemical industry:

- complete separation of valuable components of C4 and C5 fractions
- introduction of domestic production of n-hexane, n-pentane; n-octane
-
- new product replacing lead in motor gasoline: MTBE (methyl-tertier-butyl-ether)
- better valorization of raw materials for the production of NPK (Nitrogen Phosphor, Potassium) fertilizers

Plastics and Resins:

- establishing R&D departments at ARAK and BANDAR IMAM Petrochemical complexes
- reassessing the profile and field of activity of PRCI

Marine Products:

- introduction of vertical aquaculture in salt operations in the following areas:
 - shrimp culture (in evaporating ponds)
 - artemia production (in concentrating areas) and
 - salt production (in crystallizer)
 - utilization of bittern for recovering other salts
 - considering of production of beta-carotene
 - gracillaria production in the Caspian Sea

POSSIBLE FUTURE ACTIVITIES TO IMPROVE THE RESEARCH AND DEVELOPMENT INFRASTRUCTURE OF THE ISLAMIC REPUBLIC OF IRAN.

Programme title:

REORGANIZATION OF RESEARCH AND DEVELOPMENT INFRASTRUCTURE IN THE ISLAMIC REPUBLIC OF IRAN

Justification:

The sustainable and homogeneous industrial development in Iran could be achieved only with the interrelated and integrated efforts of Government, R&D Institutions, companies etc. Presently there is a lack of coordination from practical and institutional points of view between industry and the existing research and development institutions. Consequently the flow of information is rather poor between parties, esp. between R&D and market, and also between different sectors of the economy.

Objectives:

To analyze and specify the main elements of an (economical) environment which is favourable to innovation and elaborate suggestions for the creation of such a system.

As a base investigations should be made for:

- the assessment of R&D capabilities and actual needs of the industry and
- collecting information on the R&D infrastructure of several industrial countries

These investigations should also include organizational considerations on:

- structuring a Ministry of R&D
- structuring an information agency for R&D
- structuring a service network for analytical instruments

Modalities of the implementation:

1. A team of specialists from different sectors of the industry should prepare an analysis on the

- on-going and planned R&D projects and programmes of the research institutes
- structure and working method of R&D institutes
- on-going programmes of the industrial companies
- intercommunication channels between ministries
- sectoral and regional market considerations

2. A small team (of 2-3 members) of top officials of the Iranian R&D field (selected from the members of the Industrial Committee of the High Council of Research and Development) should study the different systems of R&D back-up and "bridge institutions" in industrialized countries. (Germany, France, UK, Japan, US). Their report should also go into details concerning the

- structure
- field of activity
- organization
- contacts, relationships
- staffing
- budget

of the various R&D related organizations.

Outputs:

Development programme for the innovation system of the Iranian economy based on studies including proposals containing the fields of activity, structure, detailed descriptions of organizational arrangements and modalities, manpower and budgetary requirements of a system which will improve the flow of information in the R&D field, enhance the state control on the projects, helps to coordinate the ambitions of the private sector with national priorities.

Costs:

Can be specified after the details of the above described concept have been fixed.

Annex 2.

Programme Title:

DEVELOPMENT OF INDUSTRY IN ORDER TO IMPROVE ENVIRONMENTAL PROTECTION, REDUCE DEPENDENCE ON IMPORTS AND INCREASE EARNING OF FOREIGN CURRENCY BY EXPORTS.

Justification:

The Islamic Republic of Iran is a country rich in natural resources and has a significant and quickly developing petrochemical industry. However, mineral resources (except oil and gas) and agricultural products are far less exploited than needed. Meanwhile the high growth rate of population makes difficult to fulfill the socio-economic plans of the country. Last but not least, there are severe limitations for enterprises to access to foreign currency.

Objectives:

To set up priorities and to elaborate viable projects for the development of the economy of the Islamic Republic of Iran in order to:

- improve environmental protection
- reduce dependence on imports by utilizing indigenous sources of raw materials
- increase exports, especially to the newly established neighboring republics mainly (but not exclusively) in the following fields:
 - food production
 - agricultural products
 - chemical industry (petrochemical, pharmaceutical, hygienic-cosmetic products, agrochemicals etc.)
 - introduction of the application of biotechnology in various fields (agriculture, pharmaceuticals, mining, petrochemical industry etc)
 - building materials
 - mineral resources
 - introduction of new application of renewable sources of energy

Modalities:

1. A task force should be established to set up priorities and prepare the proposals for the different projects.

2. Teams should be organized to prepare the sectoral studies/projects. Members of the task force should be distributed into the staff of the teams in order to ensure the cross information between sectors of industry and to represent reciprocal interests, needs.

Outputs:

Interrelated projects for the integrated development of different sectors of the economy resulting in the enhancement of self sufficiency and improving export possibilities.

Costs:

Can be specified after the details of the above mentioned projects have been fixed.