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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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CENTRE FOR INDUSTRIAL RESEARCH

DP/ISR/64/511

ISRAEL

TERMINAL REPORT

Prepared for the Government of Israel by the
United Nations Industrial Development Organization,
executing agency for the
United Nations Development Programme

United Nations Industrial Development Organization

id. 76-870

United Nations Development Programme

CENTRE FOR INDUSTRIAL RESEARCH

DP/ISR/64/511

ISRAEL

Project findings and recommendations

Prepared for the Government of Israel
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

United Nations Industrial Development Organization

Vienna, 1976

Explanatory notes

Reference to "dollars" ($) indicates United States dollars.

The monetary unit of Israel is the Israeli pound (IL).

Use of a hyphen (-) between dates representing years signifies the period involved, including the beginning and end years, e.g. 1971-1973.

A slash (/) between dates representing years indicates a crop year or financial year, e.g. 1971/72.

The following abbreviations are used:

Technical abbreviations

m/m	man months
PVC	polyvinyl chloride
R & D	research and development
UV	ultraviolet

Organizations

CIR	Centre for Industrial Research (Israel)
NCRD	National Council for Research and Development (Israel)
WAITRO	World Association of Industrial and Technological Research Organizations

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SUMMARY

This is the terminal report of the project for the establishment of a "Centre for Industrial Research" in Israel (DP/ISR/64/511). The Project Document was signed in March 1966 and work began in October 1966. The project was formally terminated on 30 September 1974. This report describes in detail the activities of the Centre from its inception to the end of 1974 and assesses its effect on Israeli industry.

The purpose of the project was to establish and initially to operate an industrial research centre which would be capable of promoting the application of the findings of basic research to industrial production, and thus would help to accelerate industrial development. By the end of the project, the Centre had gained the active co-operation of industry and of governmental agencies; a substantial part of its activities are now in fact financed by industry.

A major achievement of the project, as indicated in the conclusions of this report, is that it created for the first time in Israel the possibility for a research institute to plan ahead for several years and to implement plans according to changing needs and conditions. Results of a study to assess the effect of the Centre's research on the branches of Israeli industry with which it has been working show that for the period 1971-1973 it had an impact in financial terms of more than twice the amount of the total investment made to establish and operate the Centre over the period 1967-1973.

The report recommends that the Centre should receive government support for five years to allow it to grow in step with the acceleration of its activities and to meet the need for pilot plant space and an in-service training programme.

INTRODUCTION

This is the terminal report of the project for the establishment of a Centre for Industrial Research (CIR) in Israel (DP/ISR/64/511). The Project Document (referred to in this report as the Plan of Operation) was signed on 13 March 1966 by representatives of the United Nations and the Government of Israel. The United Nations was designated executing agency for the project, working through the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organization (UNIDO). The Government of Israel assigned the Technical Assistance Department of the Office of the Prime Minister as its counterpart agency.

Background

One of the most vital needs of Israel has been to enhance its industrial capabilities and to increase industrial output for both local consumption and export, in order to improve an adverse balance of trade and approach self-sufficiency. Awareness of this need has become more acute during the last decade with the recognition of the limitations and inadequacy of relying mainly on an expanding primary materials industry such as agricultural produce and minerals. Plans for the diversification of considerable means towards the development and expansion of processing industries have taken into account the availability of professional man-power in Israel with adequate technological and scientific background who may be diverted and trained to function in industry and in industrial research. This training and re-orientation towards applied research has thus become a matter of high priority.

Prior to the establishment of this project there existed an institutional infrastructure for undertaking applied research, but it was recognized that a new organization specially geared for the purpose was required in order to promote more purposeful research activities and a more successful approach to accelerated adoption of advanced technologies by industry. Most industrial enterprises in Israel were and continue to be unable to maintain and support an R & D effort owing to their relatively small size and the markets served; it was therefore deemed that the Government must take the initiative in furnishing these capabilities.

On the basis of the agreement between the United Nations Special Fund and the Government of Israel (December 1959) concerning assistance from the Special Fund, and in accordance with conditions specified therein for the provision of such assistance, both parties agreed in 1965 to create a five-year project to establish the Centre for Industrial Research (CIR).

The purpose of the project was to assist the Government of Israel in the establishment and initial operation of a centre for industrial research which should be capable of promoting the application of the findings of basic research to industrial production as a means of accelerating industrial development.

To this end and prior to the signature of the Plan of Operation, the Centre was established as a Government Corporation under the aegis of the National Council for Research and Development. (NCRD). It entered into bilateral agreements with the Israel Mining Industries, Haifa, and with the Israel Fiber Institute, Jerusalem, to combine with them as soon as practicable.

In accordance with an agreement with Technion, which is the Israel Institute of Technology, the building housing CIR's permanent laboratories was erected on the grounds of Technion City, Haifa.

According to plans, building activities should have started in 1966, in order to enable CIR to occupy permanent quarters by 1968. However, actual construction was started only at the end of 1967 and progressed slowly over more than four years; CIR moved into the unfinished premises in April 1971. The prolongation of construction activities has caused considerable delays in implementing the programme, creating a chain-reaction of further delays in the recruitment of local staff, in the purchasing of equipment and in the utilization of fellowships and expert posts.

Financial contributions

The original plan of expenditure has undergone several modifications, both in total amount and in allocations according to the components of the original Plan of Operation. In consequence of three Adjustment Advices and several project revisions, the amounts contributed total $US 15,124,845, of which $US 1,329,600 were allotted by the UNDP Special Fund, $US 1,025,245 were contributed in cash and $US 12,770,000 were contributed in kind by the Government of Israel.

Objectives

Activities

Emphasis was put on medium- and long-range industrial applied research, with the aim of developing new and improved products and processes, and on assistance to industry by consultation, by dissemination of scientific and technological information and by technical and economic analysis of new and promising technological products and processes.

Technological areas of work

Work was concentrated on food technology, plastics, textiles and fibres, and minerals and industrial chemicals, all of which are of primary significance and importance to potential export industries.

Capabilities and facilities

These were designed to establish objective-oriented laboratories and disciplinary units to execute the planned activities and to establish an efficient organizational framework for planning and carrying out industrial R & D.

Manpower improvement

The objective was to plan and implement an in-service training programme, comprised of both short- and long-term courses with the aim of updating and further developing the capabilities of the professional staff.

Phases of implementation

Field work on the project started on 13 October 1966 with the appointment of A. Baniel as General Manager and the start of recruitment of local staff. At the end of December 1966, P. B. W. Gollong assumed the post of the Project Manager of CIR for three years, after which his functions were taken over by the Resident Representative of UNDP, assisted by the CIR Chief Administrator.

The original Plan of Operation underwent three significant changes, each confirmed by an official Adjustment Advice. Adjustment Advice No. 1, signed on 11 August 1967, amended the original time-table of the Plan of Operation in view of delays in the implementation of field work and construction. Adjustment

Advice No. 2, signed on 4 August 1969, up-dated the Plan in view of major delays in the completion of the permanent laboratories, which caused delays in local staff recruitment, in placing requisitions for equipment and in implementing expert and fellowship programmes. Adjustment Advice No. 3 was signed on 10 March 1971 in view of the fact that because of accumulative delays CIR was unable to utilize all allocations by 31 December 1971.

In addition, several project revision forms were issued after 31 December 1971 to rephase the project's budget and the timing of expenditures into 1974, in order to enable the successful termination of the project by 30 September 1974.

Several policy changes also occurred during the period 1966-1974 which have had significant effects. In 1966 the Government of Israel planned to incorporate, by appropriate agreements, the newly created Centre of Industrial Research (CIR) (Technion Campus, Haifa) with the Israel Mining Industries (IMI) (Haifa Bay area) and the Israel Fibers Institute (Jerusalem). These plans were not implemented since in 1969 a government committee initiated changes in the organizational affiliation of government research institutes and placed them under the aegis of different ministries and their respective research administrations ("Katchalsky Report"). This new management became formal and functional in 1971. It did not have a significant effect on the implementation of the project, namely on fellowships and equipment.

Policy changes resulting from the new affiliations also affected changes in the management at CIR and at IMI, but not at the Fibers Institute. The management changes involved - initially and significantly at CIR and later at IMI - also changed the direction and trend of research activities and the Institute's involvement with industry. At CIR the results have been clearly discernible in terms of accelerated research undertakings sponsored and financed by industry. The reorganization is still under way at IMI and at the Fibers Institute, but new patterns have not as yet emerged.

The institution of a Country Programme in lieu of the individual projects - as per the policy change agreed upon by the United Nations and the Government - has not affected the activities within the scope of the Plan of Operation. At the end of 1973 the Government of Israel decided to terminate this project by 30 September 1974 and to complete the implementation, if needed, of all expert and fellowship components, even if not utilized completely by then.

I. SUMMARY OF PROJECT OPERATIONS

Counterpart staff

The following table describes the staff of the three member organizations, by size and function, at the termination of the project.

Staff function	Total staff	Organization		
		CIR	IMI	Fibers Institute
Management and administration	80	21	38	21
Professionals (scientists and engineers)	145	40	63	42
Technicians and others	159	41	85	33
Total	384	102	186	96

Experts

According to the Plan of Operation, 231 expert m/m were allotted to the project, of which 212 m/m were implemented as follows (for details see annex II):

	Experts	Man-months
CIR		
Project Manager	1	36
Food Institute	10	64
Plastics Institute	6	24
Sub-total for CIR	17	124
IMI	6	63
Fibers Institute	15	25
Total	38	212

Nineteen m/m were not implemented, because suitable candidates were not found or were not available by 30 September 1974, the date planned for termination of the project. It is hoped that this balance will be implemented at CIR later, within the framework of the Country Programme.

Of the 38 experts assigned, 14 had long-term assignments of 6-24 months, whereas 24 were engaged for short terms of 1-3 months.

All the experts, with minor exceptions, were gratifyingly suited to carry out their assignments and fulfilled their tasks successfully. Their contributions to the progress of IMI and the Fibers Institute, and especially to the development of CIR, have been essential. Their greatest effect has been to raise substantially CIR's scientific capabilities and to increase its professional standing. (For particulars, see annex II.)

Fellows

According to the Plan of Operation, 249 m/m for fellowships were allotted of which 198 were implemented by the Institutes as follows (for details see annex III):

	Fellows	Man-months
CIR		
Food Institute	7	18
Plastics Institute	11	32
Applied mathematics	3	7.5
Research administration	2	4
Sub-total for CIR	23	71
IMI	18	83
Fibers Institute	25	53.5
Total	66	198

Fifty-one m/m were not implemented, mainly because during the life of the project not enough suitable candidates were available; particularly towards its termination, from October 1973 onward, army service interfered with the placement of candidates. It is hoped that the Government will agree to a *modus operandi* by which the outstanding fellowship allotment will be implemented at CIR even after the official termination of the project.

Of the 66 fellows, 10 completed long-term assignments of 6-12 months, whereas 56 served short terms of 1-4 months.

Almost all fellowships were extremely well planned and highly useful both to the fellow and to his parent institute. Experience gained by the fellows definitely contributed to CIR's professional competence and standing, enabling its personnel to tackle current technological problems with professional proficiency. It helped in updating the professional capabilities of CIR, lending authority to its offers to implement new approaches in research and technology for industry.

Equipment

Within the framework of the Plan of Operation, a total of $US 1,456,445 was allotted for the purchase of equipment, mainly for laboratory R & D work, for a variety of testing equipment and for pilot plants. Of these funds roughly one third was allotted to the project by the United Nations and the remaining two thirds were made available by the Government of Israel and transferred to the United Nations, which had sole authority on decisions of procurement.

Up to the end of 1973, equipment worth approximately $US 1,400,000 had been ordered, delivered and installed in CIR's laboratories, workshops and pilot plants. Orders for the outstanding balance are expected to be placed according to plans.

The following table summarizes the distribution source of funding and costs of equipment obtained within the framework of the Plan of Operation:

Institute	Dollars	
CIR		705,445
Food Institute	260,245	
Plastics Institute	283,200	
General	162,000	
IMI		294,800
Fibers Institute		456,245
Total		1,456,490

Source of funds (equipment only)	
Special Fund allocation	480,000
Government contribution in cash	976,445
Total	1,456,445

	Source and number of items		
Category of cost	United Nations	Government	Total
Items above $15,000	5	10	15
Items $5,000-$15,000	20	30	50
Items less than $5,000	155	440	595
Total	180	480	660

Since the equipment received by the Institutes during the period 1966-1974 comprises a great number of items, only a partial list of major items and their application is given in annex IV.

Appraisal of implementation

The United Nations system of purchase and procurement proved in practice most efficient: the equipment most suited to CIR's needs was obtained very economically and yet according to specifications, and deliveries were mostly on schedule.

The flexibility and accommodation encountered by CIR among United Nations authorities, in phasing and rephasing of timing and in some cases even of sudden cancellations of equipment, has been much appreciated.

Consequently, CIR has been able to avoid situations in which equipment was held in crates or unused. All equipment received has been fully utilized and in good order. In-house maintenance and contracted technical service have enabled CIR to have all equipment fully operable, even items ordered as far back as 1966.

Main activities

General

Background and exploratory research required considerable investment of means and efforts during the whole period of the project, especially in the newly created Plastics and Food Institutes as well as in the supporting division for techno-economic services - all three within the framework of CIR.

Joint CIR-industry and interdisciplinary R & D is by now so well established that the Government as well as industry is using CIR's services, facilities and know-how not only for research and industrially related activities, but also for contract research and development, economic feasibility studies and industrial development planning.

CIR now routinely gathers and evaluates facts, figures and trends regarding the present and future growth of the local food and plastics industries, as well as export requirements and prospects. These data have served CIR in formulating a basic five-year plan for its activities and in defining priorities according to national and industrial requirements, in order to be able to fulfil its purpose of promoting applied research useful in accelerating industrial development. Part of the work done prior to October 1973 had to be re-evaluated in view of new national and international economic developments.

CIR is in the process of creating, as an additional institute, the Paint Research Laboratory. Full implementation of this project will probably be prolonged, however, since it appears now that the Paint Research Laboratory will be housed at CIR's quarters by the end of 1975.

A management information sub-system has been developed and applied at CIR, to aid management in planning, follow-up, accounting, and controlling all of its activities and finances. The system furnishes information and statistics in cross-sections applicable, correspondingly, to all levels of management from over-all through Institute and individual project management.

CIR edits and distributes two monthly publications, furnishing information on the most current literature concerning food and plastics technology. In addition, the Fiber Institute publishes a monthly journal for the textile industry.

CIR

Food Institute

The Food Institute was established within the framework of the project. From modest beginnings it has grown into an efficient, dynamic, active group of several interrelated disciplines. Its scope of activities has grown commensurately with the development of co-operation with the other disciplinary groups of CIR, enabling the Food Institute also to tackle such areas as the packaging of food products (with the Plastics Institute) and techno-economic feasibility studies, including market research (with the Division of Economics and Applied Mathematics).

Laboratories of the Food Institute by disciplines are:

(a) The food technology group is engaged in process development, including conventional and modified dehydration, freezing and sterilization, as well as in product improvement and development including products based on soya, milk, fish, vegetables, fruits and meat;

(b) The microbiology group is engaged in a wide range of activities particularly involving the micro-biological aspects of food-processing and quality assurance of food products. Its professional capabilities are recognized and acclaimed by industry as well as by government agencies, and its services are widely sought after in tackling processing line and shelf-life problems, quality assurance and control and standardization;

(c) The biochemistry group concentrates on the characterization of and quality assurance of food products, on the characterization and exploitation of enzymatic systems and on the separation of plant proteins including development of their industrial applications;

(d) The organic chemistry group is engaged in developing and applying routine procedures for the quantitative determination of pesticides residues in processed foods, in the characterization of natural products and in synthesis and reaction mechanisms (e.g. hydrogenation of edible oils) related to processed foods;

(e) The analytical and physical chemistry group activities are interwoven in the work of the Food Institute; however, direct services to industry constitute a considerable part of their programme;

(f) The organoleptic laboratory renders services both on contract and within the framework of in-house development projects. The laboratory has a special kitchen as well as individual and group-tasting facilities, with controlled temperature, humidity and lighting;

(g) The pilot plant facilities are still insufficient. At present a freezing tunnel for testing and research has been installed.

The directed applied research, coupled with emphasis on interdisciplinary planning and programmes, has led to the development of products and processes

suitable to the specific circumstances of the food industry and market of Israel, as well as to its needs for maintaining and improving a competitive standing in the export markets. Some of these are listed here:

(a) Industrially exploited developments

Stabilization of colloidal systems and modifications of rheological characteristics (e.g. juices and concentrates)

Improving the solubility of natural bitter compounds (e.g. naringin)

Stabilization and use of essential oils

(b) Product and process development

Natural fruit powders

Improved dehydration of apricots

Dehydrofreezing of fruits and vegetables

Characterization of bitter agents in processed avocado

Flavour-retaining dehydration of bananas and strawberries

Ambient temperature dehydration of vegetables

Production of a novel soya product and its utilization in conventional and new products

Non-dairy fermented products made of soy protein

Production of novel products from baccala fish

Synthesis of flavour compounds

Alleviation of waste disposal (whey) through growth of single-cell proteins

(c) Quality improvement

Microbiology of processed citrus products

Prolongation of shelf-life of dairy products

Evaluation and use of preservation materials

Development of preservation systems

Microbiological specifications and standards for processed food (public health aspects, prevention of spoilage)

(d) Quality assurance of exported processed food

Assistance with problems of in-line microbial contamination

Testing of processed citrus products, especially for export

Microbiological quality assurance of both dehydrated and frozen fruits and vegetables

Pesticide residues in processed food products
Metal residues in processed products
General guidance and instruction to industry

Plastics Institute

The Plastics Institute, established within the scope of the project, was planned in anticipation of a dynamically growing plastics industry in Israel, very much in need of an applied research institute which would be capable of rendering the scientific, engineering and techno-economical services necessary to sustain its growth and to improve its competitive standing in the export market. The Institute has acquired an excellent reputation in Israel for its record of accomplishments in filling the various needs of the plastics industry. It has an integrated team of properly trained, experienced and dedicated personnel, and suitable equipment.

The Institute engages in applied background research in the area of polymer synthesis and chemical modifications, and studies of structure and properties, such as the following:

Rheological properties of thermoplastic melts
Solubility parameters of polymers
Flame retardants in plastics
Anionic polymerization
Novel thickening agents
Thermoplastics containing metal oxides

The Institute is active in the development of specialty polymers, the formulation and preparation of compounded materials and various processing studies. These capabilities are of special interest to medium and small-sized industries, which can utilize the staff of the CIR and equipment for this purpose without incurring an investment.

The following are some examples:

Cast polyamides
Rotational casting studies
Thermoplastic foam extrusion studies
Novel asbestos reinforced vinyl plastics
Novel preparation of non-ionic surfactants
Fibre-reinforced plastics
Oriented, short fibre-reinforced plastics
Protection against UV degradation
Adhesives based on vinyl chloride/acrylate copolymers
Exploratory development of synthetic leather
Vacuum forming studies
Chemical crosslinking of ethylene copolymers
Mechanical behaviour of glassy polymers

In addition, the Institute has offered some product design, based on considerations of materials, of process and of local economic, marketing and consumption patterns, such as:

Gaskets of special design for high pressure water dialysis systems
Polymer-pesticide systems for controlled release
Application-tailored adhesives
Foamed thermoplastic injection-moulded products
Flexible laminates for packaging

The Plastics Institute also offers technical and consulting services as well as non-routine testing services and economic evaluations. Examples of consulting are:

Recommendation of materials for specific application
Recommendation of advanced production processes

Quality-control procedures and specifications

Consumers inquiries; market studies; technological surveys

Techno-economic project feasibility studies

Examples of testing are:

Effects of processing conditions

Gas permeability of films for packaging

Processing and characterization - rotational molding

Chemical analyses

Physical testing, including sample preparation of compression- and injection-moulded standard test specimens

Economics and Applied-Mathematics Division of CIR

This group began work in 1967 with two professionals as an applied-mathematics team to instruct and encourage the staff of CIR and IMI to apply computer-based and mathematical techniques in their work planning and programmes. During the last two years the Division has grown to six professionals, three specialists in applied mathematics and three economists with engineering training. The Division undertakes techno-economic assessments of projects contracted by government agencies and by industry, and participates in most in-house proprietary programmes of CIR.

It was decided in 1972 to link up CIR with Technion's IBM 370/165 computer in order to satisfy the needs and increase the capability of the Centre. To achieve this, a suitable IBM terminal was ordered in 1972. This direct link-up, however, has not been made to date because complications have arisen owing to IBM sales regulations. It appears that the equipment will, however, be installed before the termination of the project.

The Division's scope of activities include:

(a) Computer application in mathematical and statistical analysis in chemical engineering and research;

(b) Computer applications in techno-economic evaluations of proposed projects;

(c) Management information sub-systems, adapted to the needs of CIR, for budget control, project implementation and costs, and for various periodical data required for efficient R & D administration;

(d) Background and market studies, including assessments of the state of the art, of subjects involving applied mathematics and use of computers.

In addition to its routine involvement in in-house projects at CIR, the Division has been producing its self-initiated output, including:

(a) Engineering calculations by computer simulation of a new food manufacturing process, by which the dimensions of the process equipment, its costs and profitability have been evaluated according to various sets of data;

(b) Similar projects completed on contract by industry for a planned factory for the manufacture of prefabricated housing units from plastic material. The techno-economic group also took an active part in these projects;

(c) Literature review of computer simulation of liquid-liquid extraction;

(d) Preparation of a statistical plan to establish optimum experimental conditions in a most efficient manner;

(e) Analysis of corrosion in food cans;

(f) Analyses of pilot-plant data for a number of projects;

(g) In-house publication of various computer programmes adapted for local use (e.g. a sub-routine for numerical analysis and a programme for analysing crystallographic data);

(h) Market analyses, including marketing studies, up-dating of surveys and reports performed earlier, and pre-project preliminary data for feasibility studies;

(i) Economic data analyses, including feasibility of new surveys of diverse problems in industrial sectors, processes usually sponsored by Government and industry;

(j) Computer programme (ECON) was prepared for calculating various economic criteria as an aid in judging industrial projects applicable to Israeli conditions. This programme has already been marketed in its present form. It has the advantage that it can be marketed with slight modifications to different customers;

(k) Management information sub-system of CIR, now successfully in use for the second year, has during this time been broadened as well as refined. Lately the Industrial Research Administration (Ministry of Commerce and Industry) has decided to activate the system, with the help of CIR, as a sponsored project in its other Institutes.

From the above-listed output it may be seen that this group has succeeded in becoming integrated into the framework of the Centre's interests and has participated fully in its projects.

Supporting activities

The various supporting activities of CIR comprise:

(a) Services to public interests:

(i) Leading participation in several professional committees of the Israel Standards Institute;

(ii) Participation in national committees, organized by professional or trade associations in areas related to CIR interests;

(iii) Support and administration of the Israel Plastics Society (IPS);

(iv) Membership and participation in WAITRO;

(b) Publications information and documentation:

(i) Monthly newsletter to the food and plastics industries;

(ii) Publication of the Journal of the Israel Plastics Society;

(iii) Compilations and research publications on specific subjects (e.g. on tolerance limits for pesticides residues in processed fruits and vegetables; chlorination of water in food-processing plants etc.);

(iv) Information retrieval and documentation service on request;

(c) In-house technical service and maintenance:

(i) Installation of new equipment;

(ii) Maintenance of all laboratory pilot and general equipment, co-ordinated in some cases with contracted technical service;

(iii) Making accessories to existing equipment and modification of other for adaptation to special needs in research.

IMI-Institute for Research and Development

The IMI-Institute for Research and Development is located at the research and development laboratories of the Israel Mining Industries Company. The latter was founded shortly after the creation of the State; its purpose was to establish a chemical industry based on the mineral resources of the country. The initial activity of IMI focussed on the chemical analysis of the minerals, followed by process development activity such as equipment, engineering, and plant design. When the activity of IMI was reorganized in 1964, the research laboratories were set up as an independent governmental company within the framework of the Ministry of Development.

IMI joined the project's Plan of Operation and until mid-1971 it also acted as the mentor of CIR with A. Baniel as a joint General Manager.

In its present state IMI comprises the following research departments:

Process development
Organic chemistry
Materials engineering
Chemical engineering
Pilot plants
Analytical chemistry

This departmentalization is based on the fields of activity and their degree of advancement, but research workers are subject to transfer from one department to another according to need. The research activity is organized and sustained by the following administrative and supporting departments:

Business development
Patents' registration and follow-up
Finance and budget
Storehouse and purchase
Workshop, mechanics, plastics and electricity
Library and documentation
Administrative services

The research and development activity is applied along two main lines: one concerns the economic and efficient exploitation of the raw materials existing in the country (e.g. phosphates, potash, bromine, salts, magnesium and petroleum); the other is characterized by the development of new products, new technologies and modern equipment for application in the chemical industry, and by the improvement of existing products.

The efforts expended at IMI on research and development have led to an accumulation of know-how and processes the application of which within the country has helped to strengthen the chemical industry and the national economy. This effect is especially evident in the activities of the Timna Copper Mines Company, Haifa Chemicals, Arad Chemical Industries and Rami - Special Refractories.

A supplementary result of the operation of the above-mentioned companies has been the start of local engineering production of industrial equipment and the creation of new places of work.

The efforts that have been invested in the past have also resulted in the accumulation of a considerable pool of know-how and processes available for future application. It is noteworthy that IMI has developed processes which at the time of their publication were rejected as too progressive and sophisticated, but after 10 years or more these became actual. One such example is the process for the separation of magnesium salts from Dead Sea brine, published in 1956; there is great interest in its application now.

The following is a short review of IMI's activity during the last few years:

(a) Research on indigenous minerals, dealing specifically with the enrichment of rock phosphate and other minerals (e.g. potash from the Dead Sea, copper from Timna etc.);

(b) The existing minerals and intermediate products represent, on the other hand, raw materials for new improved materials. Sintering of magnesia, production of magnesia whiskers, up-grading of phosphoric acid and phosphoric esters, improvement of chloro-polymers, plastic-composites and refractories, all are examples of past investigations;

(c) Some development work has been carried out for and financed by foreign interests: completion of basic engineering for the phosphoric-acid cleaning plant in Iran; design of the extension of the cleaning plant in Mexico; and research and engineering for a food product plant;

(d) Technical service for the local industry is helping to solve problems of production (e.g. corrosion problems at the periclase plant; dust at Arad; general assistance to chemical plants such as Haifa Chemicals or Arad; special analytical services; special reviews, as on energy problems etc.).

Such specific activities have been complemented by general research work on background subjects, by exploratory investigations and research on maintenance and up-dating of existing processes, by research activity in support of work on solvents, and by analyses and investigations of corrosion, all of which form the foundation for further research work.

Plans for future research are based partly on continuity of subjects on which work has already started, but also include research on new topics of interest to the Ministry of Development. IMI plans to carry out research in those areas in which it has specialized and has proven its capability, namely:

(a) Materials and minerals engineering, such as silica glass and phosphate recovery from fine waste;

(b) Transformation and reaction engineering, particularly solvent systems and concentration of brines without the utilization of heat;

(c) Polymers and organic materials, specifically improved polymers based on vinyl chloride and production of organic compounds from magnesium bromide;

(d) Petrochemistry, such as preparation of iso-propanol, and transformation of coal and asphalt, in the framework of topics related to energy;

(e) Improvement of processes, such as testing the resistance of special reactor intended for making food-grade phosphoric acid;

(f) Development of equipment, such as new types of mixer-settlers for extraction.

The programme will encompass background and exploratory projects, analytical research and corrosion research, investigations within the framework of existing contractual commitments and complementary studies requested for the completion of research in order to reach commercialization. Supporting work includes the drafting of patents and economic evaluations.

Israel Fibers Institute

The Fibers Institute was established in 1953 and has always been an integral department of the Ministry of Commerce and Industry.

This Institute was included in the project with the intention of making it a government company, like CIR and IMI, thus allowing it some organizational independence so that it could serve industry with greater flexibility.

Its activities encompass:

(a) Analytical and testing methods in fibres, fabrics, leather and wood;

(b) Biodegradation of fabrics and factors affecting their degradation;

(c) Solvent dyeing of fibres and flameproofing of cellulosic and synthetic textile products;

(d) Laser-aided fibre cutting and solving problems involving piling, snagging and unravelling of textiles;

(e) Pilot-plant testing of new textile processes.

The Fibers Institute is also engaged in process and product development and in rendering services to processors of fibres, leather, paper, wood and textiles. The Institute is now, for the third year, engaged in teaching activities in regular programmes for students and graduate students of the Hebrew University, Jerusalem, leading to a diploma and an M.Sc. degree in textile chemistry and technology.

The Institute co-operates with the University in several research projects. It also offers information services through its library of extensive chemical and textile literature, monthly listings of textile titles, and the publication of the technical periodical Yalkut for the textile industry.

The following specialized laboratories and pilot plants carry out research and private services to industry:

Laundry and detergents laboratory and testing units
Leather laboratory
Cellulose, paper and wood laboratory
Biological laboratory
Dyeing and finishing pilot plant
Synthetic-fibre pilot plant
Chemical pilot plant

Research and service projects include:

(a) Development of analytical methods for textile chemicals;
(b) Development of rapid methods of identification and analysis of fibres and fibre blends;
(c) Analytical services for the textile and allied industries;
(d) Flame-proofing of cotton and rayon textile products:
(e) Modifying water absorption properties of cellulosic materials;
(f) Rendering synthetic fibres hyrophilic;
(g) Improving bleaching methods of cotton;
(h) Dyeing research;
(i) Adhesives and coatings for textiles and textile-laminates;
(j) Solvents dyeing;
(k) Fibres, threads and fabrics with bactericidal and fungicidal properties;
(l) Leather finishing by graft polymerization.

Product and process development comprises:

(a) Knitted articles from texturized threads;
(b) Modifying properties of sewing threads;
(c) Application of lasers in the textile industry;
(d) Piling in textile fabrics;
(e) Snagging in textile fabrics;

(f) Electrical properties of fibres and fabrics;
(g) Stretch fabrics;
(h) Research (survey) on Israeli cotton;
(i) Production of threads from cotton-rayon blends;
(j) Quality control of fabrics in industry;
(k) Computer-programmed investigation of weaving parameters;
(l) Dimensional stability of knits;
(m) Non-woven textile structures.

II. ASSESSMENT

General assessment of counterpart performance

The Government of Israel has done its utmost to fulfil the agreement signed with the United Nations, as evidenced also by the fact that the in-kind component actually disbursed was greater than originally pledged, even when devaluations are taken into account.

The planned size of staff has been achieved, although at a slower rate of growth, having taken eight years instead of five years as originally envisaged.

The main reason for taking longer than five years to accomplish all objectives laid down in the Plan of Operation has clearly been the unforeseen delay in the completion of the CIR permanent laboratory building. Plans called for completion and occupation of the building by April 1969, but it could not be occupied before April 1971.

It should be pointed out that one of the most outstanding aspects of this project has been the care and conscientiousness with which equipment and experts have been chosen and fellowships granted. It is also noteworthy that all equipment is fully in use and extremely well kept and accounted for.

It is evident from the reports submitted by the experts and fellows that very good use has been made of the time and money expended in these categories of the project.

The progress of IMI and of the Fibers Institute was not impaired by the delay in completing the central laboratories building; they were able to make use of all their allocations in kind: equipment, fellowships and experts.

The central CIR organization, comprising the newly established Institutes, was faced with delays in construction and was able to utilize its allocations only in the last two years of the project, and then only for in-kind and equipment. The allocations for fellowships and experts were not fully utilized.

Scientific and technical performance of counterpart

IMI, which joined the project as an already successful industrial research institute, was the model and mentor for CIR in its formative years. Both the IMI director and his deputy held the same positions at CIR as well and were made responsible by the CIR board of directors for organizing and developing CIR according to the IMI model.

The inclusion of IMI in the project served conversely to improve its own capabilities, to modernize its equipment, to broaden the scope of its activities and to expand its disciplines. Thus, it had greater impact on the development of the chemical industry in Israel, and also permitted it to export several proprietary processes successfully.

The Fibers Institute has also made excellent use of all its allocations in spite of handicaps such as unsatisfactory quarters and a somewhat restrictive organizational framework as an integral part of a ministry. Its association with the project undoubtedly enabled it to develop and to contribute more significantly to the industries within its concern.

CIR was organized by its first director and his deputy into two disciplinary groups, namely for food technology and plastics. This goal was successfully achieved, and on this basis the new management, which took over in July 1971, was able to initiate and emphasize more industrially oriented research activities and more involvement with local industry through technical and techno-economic services.

CIR by now has gained an esteemed position in the food and plastics industries and among the respective government agencies. This has been achieved through conscientious efforts in tackling vital industrial problems and in executing undertakings and contracts well and on schedule.

One aspect of this project, namely in-service training, comprising short- and long-term study programmes at CIR for developing technical manpower, has not been fully implemented in all member institutes. The Fibers Institute has become appreciably involved in educational activities at the University of Jerusalem; CIR offers short-term, in-house training of food microbiology quality-assurance technicians; and some staff members from all three member institutes engage in teaching and instruction at nearby universities or technical schools, and have a few graduate students working on projects towards an advanced degree.

The project in relation to government policy

The high proportion of government contribution to the project indicates the appreciation of the Government, and to a great extent has contributed to the success of the project. The project was conceived in 1964/65; field work started only at the end of 1966, however. The war of 1967 caused many economic and industrial changes and also delayed building activities because of changes in government priorities. Also the Government rearranged its research programmes and the administrative organization of its research institutes, thus in effect preventing an organizational association of IMI with CIR proper. As regards the organizational association of the Fibers Institute with CIR, plans have not been pursued.

Since the reorganization of the administration of government research institutes, the National Council for Research and Development (NCRD) has no longer been directly responsible for the policy and budget of CIR. The NCRD has become a counselling body without involvement in the operation of CIR.

CIR functions now as a Government Corporation under the aegis of the Chief Scientist of the Ministry of Commerce and Industry, through the Ministry's Industrial Research Administration. The Fibers Institute falls within the same administrative framework but has not yet been granted the status of a Government Corporation.

IMI is still under the aegis of the Ministry of Development; hence its organizational association with CIR is not feasible. While both IMI and CIR still co-operate in all matters pertaining to the project, it is unlikely that a working association will come into affect even after the termination of the project.

Without the long-term contractual obligations of the project and the definite commitments as outlined in the Plan of Operation, CIR would have not been able to survive, develop and attain its present competence and size, in view of the changes in government policy during the implementation period of the project.

Even with the obligations and commitments of the Government as defined by the project, the Centre's management has had to press forcefully for in-kind funds and do its utmost to fulfil its obligations according to the Plan of Operation.

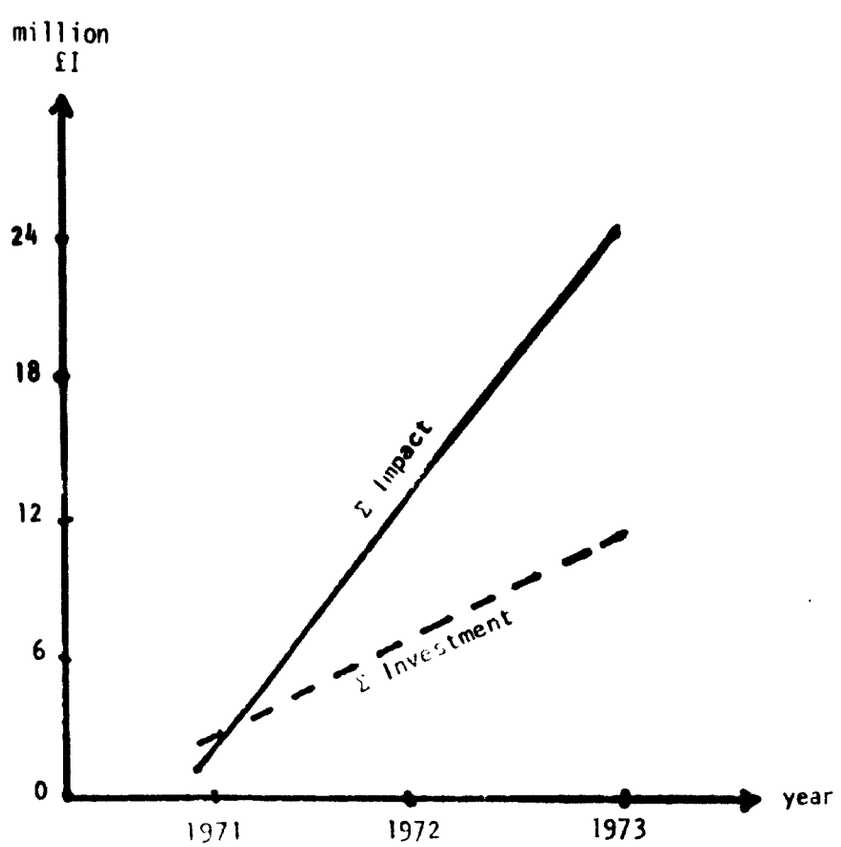
In view of the established capabilities and competence of the CIR, the Government definitely plans to support its continued existence even though it is presently not clear whether it would expand it further.

The impact of CIR activities on industry

A study was completed at the Centre to assess the impact of its research on the branches of Israeli industry with which it is working. The study was based on available figures for the years 1971-1973 (three years) in regard to the plastics industry, the food-processing industries and the export of products.

To assess the effect of research on industry is in itself a difficult task even in the most advanced industrialized countries. In view of CIR's short history of involvement in applied research for industry, it would be presumptuous to state its exact impact. By applying only the most conservative criteria and careful procedures, however, a quantitative measure in monetary terms has been determined. The results of this study showed clearly that the impact in 1971-1973 was more than twice the sum of the total investment made in establishing and operating the Centre in the years 1967-1973.

The following graph shows the achievement of an impact of approximately 24 million $I while investment and earnings totalled approximately 11.5 million $I.



Assessment of United Nations expert assistance

During the eight-year period of the project all member institutes benefitted to a great extent from guidance provided by the experts, who in most cases were prominent in their disciplines in their home countries and internationally. Undoubtedly, this component of the project had in most cases an immediate and long-lasting effect on the work of the local staff and in several cases also on industry. Often new disciplines, new areas of research and new technologies or techniques were introduced and taken over by the local staff as a result of the experts' guidance.

In most cases the expert was requested to provide advice and guidance of the following kind:

(a) To define objectives according to present and future needs of industry;

(b) To make recommendations for the implementation of these objectives in practical terms;

(c) To evaluate the local staff's capabilities to implement these objectives and to recommend future manpower policy and equipment procurement needs and policy;

(d) To define fields of research and rate their priority;

(e) To expand interinstitutional and interindustrial professional communication and co-operation;

(f) To visit and assess plant operations and to recommend measures of improving performance.

In most instances the member institutes and the concerned government agencies accepted the recommendations made by the experts, especially as regards research subjects, priorities and techniques.

An illustration of the contribution of an expert is provided by the case of the expert for textile chemistry, Professor Raymond H. Peters, at the Institute for Fibers and Forest Products Development, Jerusalem. Professor Peters came in 1969, 1970 and 1971 for terms of circa a month each. His work programme for each term consisted generally of two parts:

(a) Planning projects and research activities with the local staff and planning a study course in textile chemistry, offered by the Institute in conjunction with the Hebrew University, Jerusalem;

(b) Delivering a series of lectures in textile chemistry.

Professor Peters participated actively and continuously in the implementation of the programmes recommended and initiated by him.

Another example may be found in the final report on wood technology research by E. J. Gibson, dated 21 December 1969. His recommendations to establish a small group in this discipline at the Fibers Institute and his advice in regard to its future activities were generally followed and implemented. His proposals for a much larger group with a long-term budget and a direct association with CIR in Haifa were not deemed desirable in consideration of national plans and priorities and were not implemented.

CIR was fortunate in having the services, assistance and guidance of an expert for almost three years, namely Paul B. W. Gollong, Project Manager. Mr. Gollong succeeded during his tenure in establishing a sound basis for co-operation between CIR, local agencies and United Nations authorities. His activities enabled CIR to obtain equipment smoothly and economically, to arrange for experts and fellowships and to continue the progress of the organization and activities even without a new Project Manager taking over after his departure.

Assessment of United Nations assistance to the project

In spite of the fact that United Nations financial participation, relative to government participation in kind and cash, was not outstandingly high, the United Nations investment in all its constituents had a most significant effect on the implementation and the outcome of this project. It served as an excellent starter mechanism, setting in motion an accelerated development that can seldom be achieved by projects of this character.

One of the most important and significant results of the project was the binding commitment by the Government to pursue consistently its implementation.

The agreement by which all equipment was procured through the good offices of the United Nations enabled CIR to purchase the best and most suitable equipment in a planned, orderly and careful manner.

Experts and fellows were selected carefully, for reasons and purposes well considered and appreciated and with obviously good results. The major reason that central CIR has not been able to fully utilize the allocation for experts and fellowships by the termination of the project stems from the delays experienced

during the first several years of the project, when it was not yet developed enough to benefit from them. On the other hand, during the latter part of the project it was felt that the ability of the United Nations to accommodate experts and fellows has not always been expedient enough. But this aspect was alleviated greatly by the readiness of the United Nations to allow procedural changes when these were vital.

III. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

At the termination of the project CIR had established an excellent reputation as an institute for industrial research, actively co-operating with industry as well as with government agencies.

The bilateral agreements by which central CIR should have formed an association with IMI and the Israel Fibers Institute, as soon as practicable, have not been implemented. A formal and close association between the three Institutes was not attained, although some co-operation in policy and organizational matters exists. This situation is the outcome of the decision by the Government to change the organizational affiliations of its research institutes, relating them to different Ministries and thus to different Chief Scientists and research administrations. On the other hand, it is tentatively planned to associate two other, smaller research institutes on the Technion Campus with CIR.

To satisfy the increasing requirements of dynamically growing Israeli industry, CIR will have to further develop and maintain its professional competence and to broaden its disciplinary basis. This in turn will call for continuing involvement and support by government authorities.

The prolongation of the project notwithstanding, part of the expert and fellowship allocations have not been expended. Central CIR was not able to fully utilize its allotments because of delays in the completion of its permanent laboratory building which, in turn, delayed the expansion of its staff and limited its freedom to release employees on fellowships. Lack of work space and initial delays in the development of some disciplinary groups also caused difficulties in accommodating and utilizing the expert allocation. Moreover, because of extremely careful considerations CIR was at times unable to obtain appropriate candidates for expert posts and to place fellows suitably.

The fact that a definite time-table was not drawn up for the completion of the permanent laboratories of CIR had damaging effects on the initial development of this project. In future projects a more binding agreement as regards the immediate availability of suitable temporary laboratory space, or the preparation of permanent quarters, should be assured explicitly in the original agreement and in the Plan of Operation to avoid delays in the implementation of the other components of the project.

The major achievement of this project, apart form its successful implementation, is undoubtedly its effect on the attitude of national authorities who now concede that continuous and long-term planning is essential for research institutes in order to achieve their goals. This project created, for the first time in Israel, the possibility for a research institute to plan ahead for several years and to implement plans according to changing needs and conditions.

Recommendations

Now that CIR is established as an effective and vital organization, it is recommended that every effort should be made by the Government within the framework of its planning and policy to follow up its past and present involvement in the continuous development of CIR to enable the Centre to keep in step with the needs of the industries it serves. The following recommendations regard the future of CIR:

1. CIR should receive assistance to grow and to encompass new disciplines not yet covered by work of other existing applied research institutions. The present readiness to incorporate a small institute, such as the paint research laboratory, is a commendable beginning in this direction.

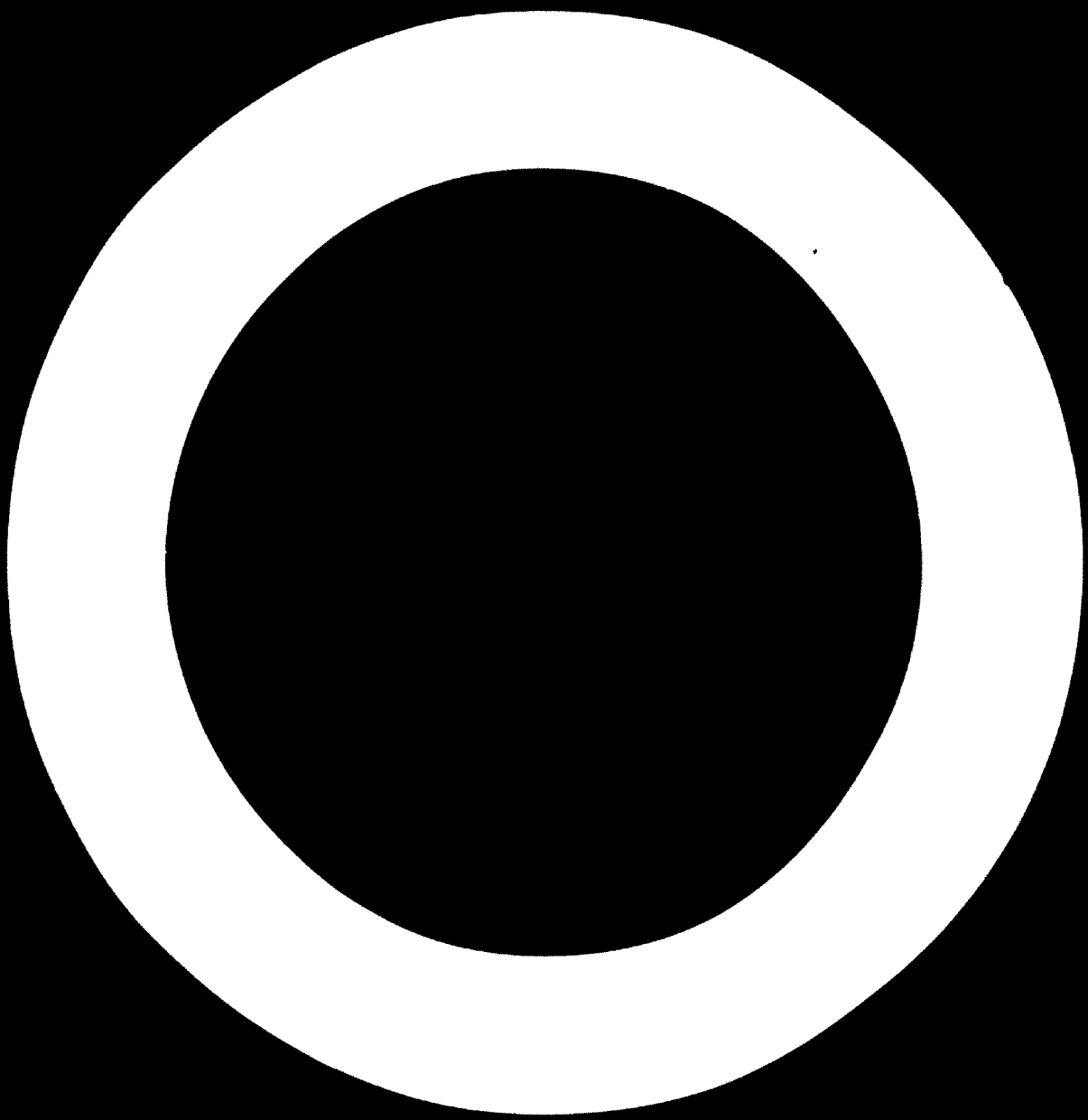
2. It should be stressed that during the last three years the funds allocated to CIR from the government budget have not grown proportionately to the need for further accelerating the Centre's activities, and such spending should be increased.

3. In view of the fact that with the termination of the project future needs for equipment and its renewal and for the recruitment of experts and the arrangement of fellowships must be borne by CIR itself, sufficient allowances should be included for this purpose in future budgets.

4. CIR is very deficient in pilot-plant space and the Government should correct this insufficiency, which otherwise may jeopardize the Centre's capability of assisting industry in a meaningful manner. This would bridge the gap between bench research and application in industry.

5. A programme should be devised to implement an in-service training programme at CIR. If this cannot be undertaken by CIR alone, a way of co-operation with the Technion should be found.

6. Every effort should be made to enable industrial research institutes like CIR to operate with at least a five-year plan, adjustable according to needs and conditions. This would furnish a firm base for efficient planning, utilization of resources and quality of performance. CIR has matured and become capable of rendering assistance to similar institutes in developing countries, offering to share its experience in both successful achievements and mistakes.



Annex I

DEVELOPMENT OF RESEARCH ACTIVITIES, 1967-1974
(Percentage)

Category of research activity	CIR		IMI		Fibers Institute	
	1967	1974	1967	1974	1967	1974
Background and literature research (in-house)	45	10	10	10	5	5
Free non-sponsored research (in-house)	50	15	20	10	10	7
Joint research with industry		10	-	-	20	-
Sponsored research for industry with subsidy by Government		25	10	15	35	52
Sponsored research for industrial client	2	20	40	45	5	-
Consulting service against payment		5	10	10	5	7
Tech-service to industry against payment	1	10	10	10	18	22
Free Tech-service to industry	2	3			2	4
Miscellaneous						
Lecturing at universities		1				1
Training of industrial staff						1
Information service		1				1
	100	100	100	100	100	100
Manpower of institutes	5	102	150	186	63	96
Total m/m expended by institutes	7,500		16,000		9,500	

Annex II

UNITED NATIONS EXPERTS IN THE FIELD, 1966-1974

Budget line	Name of expert		Job description	Institute	Implementation Year	Implementation m/m	Remarks
11-01	P. Gollong	(US)	Project Manager	All	1966-1969	36	
11-02	W. Stanley	(US)	Citrus technology	Food	1968/69	12	
11-03	S. Weller	(US)	Petrochemistry	IMI	1971/72	12	
11-04	H. Gesser	(Canada)	Surface chemistry	IMI	1968/69	12	
11-06	A. Sookne	(US)	Textile technology	Fibers	1968	3	
11-07	L. Weiner	(US)	Textile physics	Fibers	1970	1	
11-08	E. Linusson	(Sweden)	Food technology	Food	1973	3	Institutional feeding
11-09	R. Peters	(UK)	Textile chemistry	Fibers	1968/69	1	
11-10	P. Stern	(Fed. Rep. of Germany)	Physical organic chemistry	Food + IMI	1969-1971	24	Catalyses in hydrogenation
11-11	G. Jordan	(UK)	Plasma technology	IMI	1970/71	12	
11-12	S. Schwimmer	(US)	Biochemistry	Food	1973/74	16	Transformation of vegetable proteins
11-13	J. Katz	(US)	Magnetic ceramics	IMI	1973/74	14	
11-14	D. Bradley	(UK)	Inorganic polymers	IMI	1974	1	
11-20	H. Kaufman	(US)	Polymer science	Plastics	1968	2	
11-21	M. Chaikin	(Australia)	Wool technology	Fibers	1968	1	
11-22	P. Grosberg	(UK)	Textile technology	Fibers	1969	1	
11-23	E. Gibson	(UK)	Wood technology	Fibers	1969	2	

Budget line	Name of expert		Job description	Institute	Implementation Year	Implementation m/m	Remarks
11-24	L. Weiner	(US)	Textile physics	Fibers	1970	1	Follow-up mission
11-25	H. Kaufman	(US)	Polymer science	Plastics	1969	1	Follow-up mission
11-26	R. Peters	(UK)	Textile chemistry	Fibers	1970	1	Follow-up mission
11-27	E. Steiner	(UK)	Food technology	Food	1972	3	CIR activities in relation to Israeli food industry
11-28	R. Peters	(UK)	Textile chemistry	Fibers	1971	1	Follow-up mission
11-29	S. Sellow	(US)	Textile finishing	Fibers	1972	2	
11-31	G. Hearle	(UK)	Textile physics	Fibers	1972/73	1	
11-33	J. Nickerson	(US)	Food technology	Food	1971/72	1	
11-34	R. Sinia	(Netherlands)	Packaging	Food			
11-35	V. Stannett	(US)	Consultants	Fibers	1972	2	Textile technology
11-35	I. Rattee	(UK)	Consultants	Fibers	1972	1	Colour chemistry
11-35	A. Di Benedetto	(US)	Consultants	Plastics	1973	2	Engineering materials
11-35	S. Hersh	(US)	Consultants	Fibers	1973	1	Quality control marketing
11-35	M. Solberg	(US)	Consultants	Food	1973	2	Food technology and microbiology
11-35	M. Linfield	(US)	Consultants	Plastics	1974	1	Synthesis and utilization of surfactants
11-35	E. Kampelmacher	(Netherlands)	Consultants	Food	1974	1	Zoonosis and food microbiology
11-37	S. Dershowitz	(US)	Textile product development	Fibers	1972	6	
11-38	R. Lavengood	(US)	Composite materials	Plastics	1972/73	12	

Budget line	Name of expert		Job description	Institute	Implementation Year	Implementation m/m	Remarks
11-40	E. Eschinasi	(US)	Food products technology	Food	1972/73	14	
11-41	H. Gabelnich	(US)	Plastics materials	Plastics	1973	6	Bio-engineering
			Total man months implemented			212	Out of 231 allotted

Annex III

FELLOWSHIPS IMPLEMENTED, 1967-1974

Budget line	Recipient	Institute	Subject of study	Year of implementation	Duration m/m	Host country or organization
31-11	A. Morris	Administration	Research administration centre	1969	2	Norway Netherlands United Kingdom Federal Republic of Germany UNIDO
37-08	Z.Eylon	Administration	Administration of research organizations	1972	2	United Kingdom Netherlands Norway
31-55	L. Shorr	CIR	WAITRO	1971+3	1	-
31-04	S. Weissman	Food	Microbiology	1969	4	Switzerland Federal Republic of Germany Netherlands United Kingdom
31-01	A. Dolev	Food	Citrus products	1970	6	Switzerland Federal Republic of Germany Netherlands United Kingdom United States Canada
31-45	A. Zirlin	Food	Food colloids	1972	1	United States
31-02	M. Tishel	Food	Citrus products	1972/73	2	Sweden Netherlands

Budget line	Recipient	Institute	Subject of study	Year of implementation	Duration m/m	Host country or organization
31-43	S. Hadas	Food	Microbiology - fungi	1972	2	Netherlands United Kingdom
37-03	G. Ben-et	Food	Chemistry of fats and oils	1972	3	United States
31-05	G. Salee	Plastics	Thermoplastic materials	1969	6	United States
31-07	B. Khadrai	Plastics	Design of plastic equipment and dies	1970/71	4	United Kingdom Federal Republic of Germany
37-04	G. Ezra	Plastics	Plastic foams, water-soluble resins	1972	2	Switzerland Federal Republic of Germany United Kingdom
31-49	M. Narkis	Plastics	Polymer physics	1972	2	United States
31-47	L. Kacir	Plastics	PVC processing	1972	1.5	United Kingdom Norway
31-50	B. Schneier	Plastics	Mechanical testing of plastics	1972	6	United States United Kingdom
37-24	J. Miltz	Plastics	Processing and characterization of thermo-plastics	1973	2.5	Scandinavia United Kingdom Netherlands
37-19	L. Kacir	Plastics	Processing and evaluation of thermoplastics	1973	3	United States
37-27	E. Joseph	Plastics	Plastics technology	1973	2	Austria Federal Republic of Germany Netherlands

Budget line	Recipient	Institute	Subject of study	Year of implementation	Duration m/m	Host country
37-22	N. Rosenzweig	Plastics	Plastics processing	1973	1	Finland Denmark
37-26	L. Pauker	Plastics	Polymer science	1973	2	Italy
31-54	M. Goldberg	Mathematics	Computer application	1972	2	United States
37-21	B. Grooper	Mathematics & economics	R & D techno-economic problems	1973	2.5	United States United Kingdom Norway
37-23	N. Yacoub	Mathematics & economics	Computer applications in chemical engineering	1973	3	United States
31-09	M. Shorr	IMI	Corrosion of construction materials	1967	3	United Kingdom Switzerland France
31-10	S. Lavie	IMI	General research patents	1968/69	8	United States
31-08	A. Vromen	IMI	X-ray diffraction fluorescence	1968/69	6	United States
31-28	M. Glasberg	IMI	Research laboratory construction	1969	2	Switzerland Federal Republic of Germany United Kingdom
31-52	J. Waterman	IMI	Preparation on stabilization of polymers	1970	2	United Kingdom
31-24	B. Paschkes	IMI	Electrochemical phenomena	1970	6	Italy Switzerland

Budget line	Recipient	Institute	Subject of study	Year of implementation	Duration m/m	Host country
31-23	J. Schwartz	IMI	Materials engineering	1970	4	United States
31-19	D. Meyer	IMI	Pilot-plant engineering	1970/71	12	United Kingdom
31-26	G. Gorin	IMI	High-temperature microscopy	1971	3	United States United Kingdom
31-29	T. Wasserman	IMI	Analytical chemistry	1971/72	3	Switzerland United Kingdom
37-01	Y. Klopstock	IMI	Chromatography	1972	4	Federal Republic of Germany
37-06	S. Feller	IMI	Analytic separation	1972	3	United States
31-37	P. Rona	IMI	Thermolytic processes	1972	2	United States Mexico Italy
37-07	P. Spitzer	IMI	Petrochemistry	1972	3	France
37-12	E. Barnea	IMI	Chemical equipment performance	1972	3	United Kingdom Canada United States
37-13	K. Hajdu	IMI	Chemistry of solutions	1972	2	Austria
37-11	J. Gai	IMI	Industrial crystallization	1972/73	6	Europe United States
37-20	A. Ovadia	IMI	Electronic instrumentation for chem. laboratories	1973	3	United States
37-14	R. Blumenthal	IMI	Technologies in chem. engineering	1973	1	United Kingdom Switzerland Federal Republic of Germany

Budget line	Recipient	Institute	Subject of study	Year of implementation	Duration m/m	Host country
37-09	M. Schorr	IMI	Corrosion & materials	1973	2	Japan
37-05	H. Riskin	IMI	R&D in administration	1973	2	United States
37-25	E. Hadas	IMI	Design, fabrication use & maintenance of chemical plant equipment	1973	3	United States
31-15	G. Wolff	Fibers	Laundry and detergents	1967	3	United Kingdom Netherlands Sweden
31-14	J. Nataf	Fibers	Fibre testing instrumentation	1967	2	United Kingdom France Austria Italy
31-16	C. Frydman	Fibers	Fibre biology	1967/68	4	United Kingdom Sweden Denmark Netherlands Belgium France Switzerland
31-21	S. Horowitz	Fibers	Textile testing	1968	4	United Kingdom France Switzerland Belgium Netherlands

Budget line	Recipient	Institute	Subject of study	Year of implementation	Duration m/m	Host country
31-57	E. Zioni	Fibers	Research administration Fibers Institute	1968	1	Sweden United Kingdom Netherlands
31-18	C. Smith	Fibers	Wood and wood pulp technology	1968	4	United Kingdom
31-17	J. Banjabi	Fibers	Textile physics	1968/69	7	United Kingdom France Sweden
31-12	D. Ader-Barlas	Fibers	Analytical separation techniques	1968/69	6	Italy United Kingdom United States
31-27	M. Shiloh	Fibers	Textile physics	1969	2	Netherlands Ireland Sweden
31-20	B. Toker	Fibers	Wood chemistry	1969	4	United States Finland Norway
31-22	P. Cats	Fibers	Laundry technology	1970	2	United States
31-53	P. Isaacs	Fibers	Textile finishing	1971	1.5	United States
31-32	Y. Litav	Fibers	Textile physics	1971	2	United Kingdom Ireland Netherlands
31-35	E. Zioni	Fibers	Research administration	1971	1	United States Netherlands Austria

Budget line	Recipient	Institute	Subject of study	Year of implementation	Duration m/m	Host country
31-58	E. Kassierer	Fibers	Pilot melt spinning machines	1972	1	Federal Republic of Germany
31-33	J. Perel	Fibers	Textile testing	1972	3	United Kingdom
31-13	A. Ganez	Fibers	Textile chemistry	1972	2	Switzerland United Kingdom
31-10	A. Basch	Fibers	Analytical textile chemistry	1972	1	United Kingdom
37-10	B. Toker	Fibers	Paper technology	1972	1	Finland
37-18	H. Guttmann	Fibers	Fibres chemistry	1973	2	United Kingdom Sweden United States Canada

Annex IV

SAMPLES OF MAJOR EQUIPMENT ($US 5,000 and above)
(Purchased in the framework of Plan of Operation)

Type of equipment	Cost in $US	Main application: R&D	Main application: Technical service	Remarks regarding use of equipment
General services				
Thermocompressor water still	7,000		x	Infrastructure of laboratory services
Water chilling unit	6,000		x	Infrastructure of laboratory services
Workshop lathes, welding and drilling equipment	15,000		x	Technical service - workshop equipment
Food Institute (CIR)				
Multi-purpose gas chromatograph	20,000	x	x	Testing service for export industries Original chemical analyser for Food and Plastics Institute
Infra-red spectrometer	7,500	x	x	Chemical analyser
Laboratory centrifuges	8,000	x		Biochemical and microbiological work
Amino acid analyser	15,000	x	x	Chemical and biochemical analyser for Food Institute Service for export industries
Recording spectrometer	15,000	x	x	Chemical and biochemical analyser for Food Institute Service for export industries
Laboratories freeze-drying plant	5,000	x	x	Technological food research
Mobile spray-drying unit	5,000	x	x	Large-scale studies for same

Type of equipment	Cost in $US	Main application: R&D	Main application: Technical service	Remarks regarding use of equipment
Cabinet dryer	10,000	x	x	Microbiological research
Fermentor	10,500	x	x	Bio-technological research
Plastics Institute (CIR)				
Tensile rheological testing machine	13,000	x	x	Testing of most mechanical properties in tensile and compression at wide ranges of temperatures and rates
Polymer visco property control system	20,000	x	x	Broad rheological studies of polymer melts
Single-screw injection molding machine	22,000	x	x	Molding of various temperatures, pressures, cycles and molds
Two-roll laboratory mill & accessories	34,000	x	x	Processing of thermoplastics and thermosettings
Mixing and kneading machine	6,000	x	x	Compounding dry and molten polymers
Plasticity measuring apparatus	9,000	x	x	Following chemical reactions, compounding and processing of polymeric systems
Single-screw extruder	17,000	x	x	Extruding profiles, films, pipes, blowing etc.
Rheovibron visco-elastometer	8,000	x		Mechanical spectroscopy in wide range of temperatures and frequencies
Economics and Applied Mathematics Division				
Programmable desk calculator and communications terminal systems	13,000	x	x	Service for all Institutes

Type of equipment	Cost in $US	Main application: R&D	Main application: Technical service	Remarks regarding use of equipment
IMI				
Atomic absorption spectrophotometer	11,000	x	x	Analytical department of over 40 elements The most versatile and useful piece of equipment in the analytical laboratory
Spectrophotometer	10,000	x		Ultra-violet and visible colorimetric determinations For all determinations of substances in the UV region
Elementary analysis combustion apparatus and accessories	5,000	x		Determination of CHNO; for organic elementary analysis
Reactor DK - 500	8,500	x		Various high pressure synthesis; for organic synthesis
Stirrer-type glass pressure reactor	5,000	x		High pressure organic synthesis where glass lining is essential; organic synthesis
Differential scanning colorimeter	9,000	x		Determination of specific heat of reactions and materials Analytical applications mainly
Gas chromatograph model 900	10,000	x		Separation and qualitative/quantitative determination of organic compounds; organic analytic
Induction plasma torch system	25,000	x		Study of reactions at very high temperatures; used in material engineering
Linear-wave number grating spectrophotometer	10,000	x		Infra-red spectroscopy for indentification and quantitative determination of organic structures; used in organic analysis

Type of equipment	Cost in $US	Main application: R&D	Main application: Technical service	Remarks regarding use of equipment
Laboratory polymerization autoclave and accessories	5,000	x		Preparation of polymers; polymer studies
Israel Fibers Institute				
Ultraviolet recorder spectrophotometer	7,500	x	x	Analytical research and services Basic to all investigations involving solutions, dyes; important quantitative tool
Laboratory synthetic spinning machine and accessories	40,000	x	x	Production of experimental fibres; used to research the effects of variable on the properties of synthetic fibres
Instron textile tester	17,000	x	x	Evaluation of experimental process on fabrics services Indicates effects of chemical (including laundry) physical and biological influences on tensile strength
Textile dyeing and finishing range	63,000	x	x	Large-scale studies on new textile processes; simulation of commercial equipment in development of new textile processes
Gas chromatograph, digital fibrograph, hydrogen generator, knit shrinkage gauge	18,000	x	x	Analytical research Qualitative and quantitative analysis; research and services

Type of equipment	Cost in $US	Main application: R&D	Main application: Technical Service	Remarks regarding use of equipment
Ulster evenness tester	5,000	x	x	Services to industry; quality control
Automatic yarn strength tester	7,000	x	x	Services to industry; quality control
Fibre analysis knitter	8,000	x	x	Experimental knitting procedures; knitting research
Precision universal milling machine	10,000	x	x	Fabrication of parts for equipment repair, modification Maintenance and equipment fabrication
High temperature static pressure-dyeing plant	11,000	x	x	Pressure dyeing; dyeing fabric for research applications
X-ray diffraction apparatus	32,000	x	x	Establishment of fundamental polymer structural parameters and changes due to synthesis or subsequent modifications

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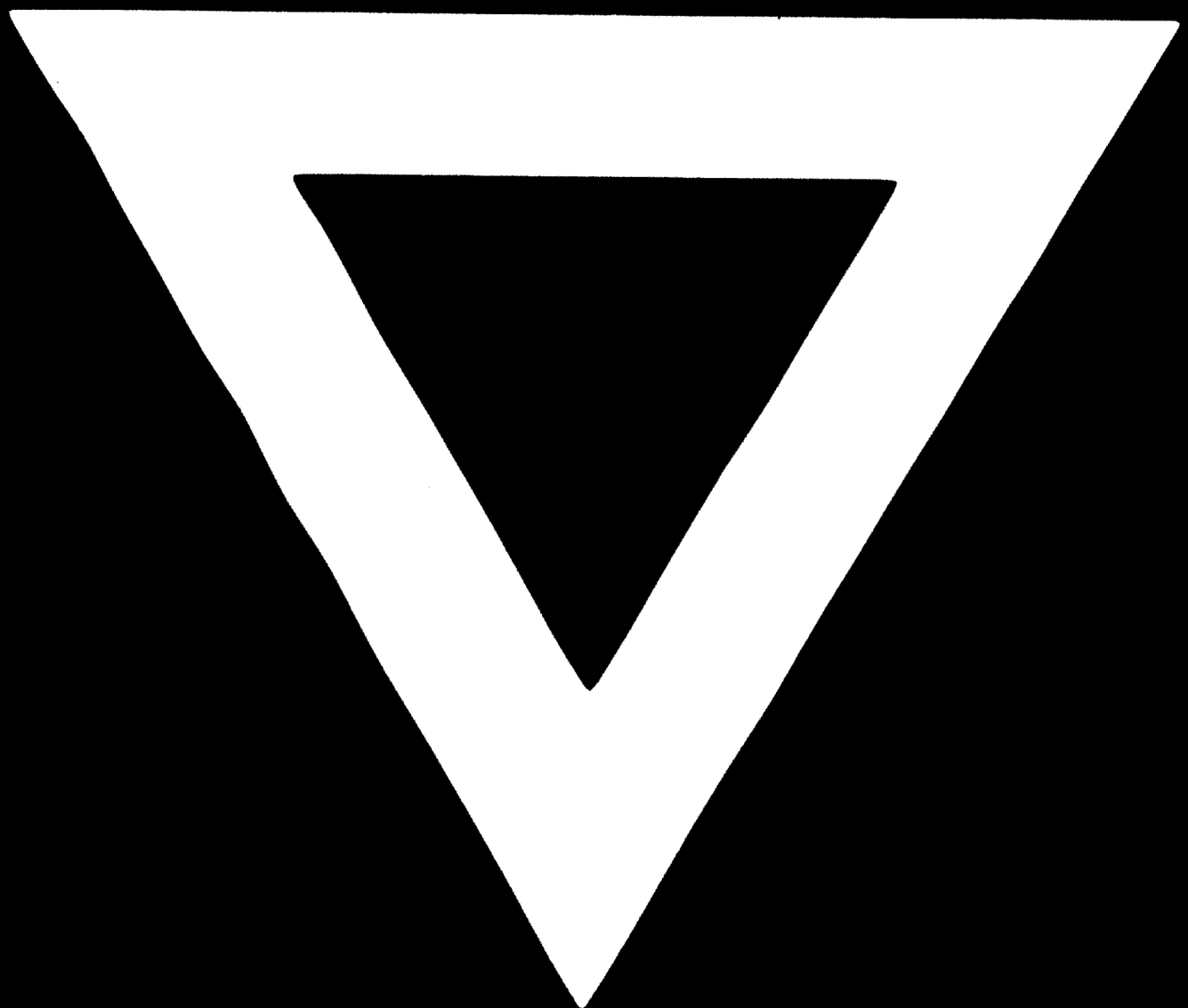

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