

No. 33

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)  
MINISTRY OF COMMERCE AND INDUSTRY  
THE SULTANATE OF OMAN

STUDY  
ON  
ESTABLISHMENT OF INDUSTRIAL RESEARCH CENTER  
IN  
THE SULTANATE OF OMAN

JULY 1996

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## Preface

In response to a request from the Government of the Sultanate of Oman, the Government of Japan decided to conduct the Study on Establishment of the Industrial Research Center in the Sultanate of Oman, and entrusted the study to Japan International Cooperation Agency (JICA).

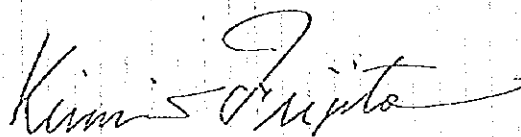
JICA sent a study team led by Mr. Masayasu Sakanashi of UNICO International Corporation, to the Sultanate of Oman three times from December 1995 to June 1996.

The team held discussions with the officials concerned of the Government of the Sultanate of Oman, and conducted related field surveys. After returning to Japan, the team conducted further studies and compiled the final results in this report.

I hope this report will contribute to the promotion of the plan and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Sultanate of Oman for their close cooperation throughout the study.

July 1996



Kimio Fujita  
President

Japan International Cooperation Agency



July 1996

Mr. Kinio Fujita  
President  
Japan International Cooperation Agency  
Tokyo, Japan

Dear Mr. Fujita

**Letter of Transmittal**

We are pleased to submit to you the final report on the Study on the Establishment of Industrial Research Center (IRC) in the Sultanate of Oman. The report contains the evaluation and clarification of needs for technical support which is useful for promoting industrial development in Oman, and the formulation and recommendation of conceptual plan and detailed plan of the IRC which is to be established to provide technical support satisfying the needs.

Oman started the Fifth Five-Year Plan in 1996, in which it is planned to establish the IRC as one of government's support programs for the promotion of industrial development. The plan recommended in the report provides the basis for finalizing the plan for the establishment of IRC, the implementation of which, we believe, will bring about substantial contribution to the industrial development in Oman.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of International Trade and Industry of the Government of Japan and the Embassy of Japan in the Sultanate of Oman for valuable advice and support provided on this study. We also wish to express our deep appreciation to the Ministry of Commerce and Industry and other relevant authorities of the Sultanate of Oman for the close cooperation and substantial assistance extended to us during our investigations and study.

Very truly yours,

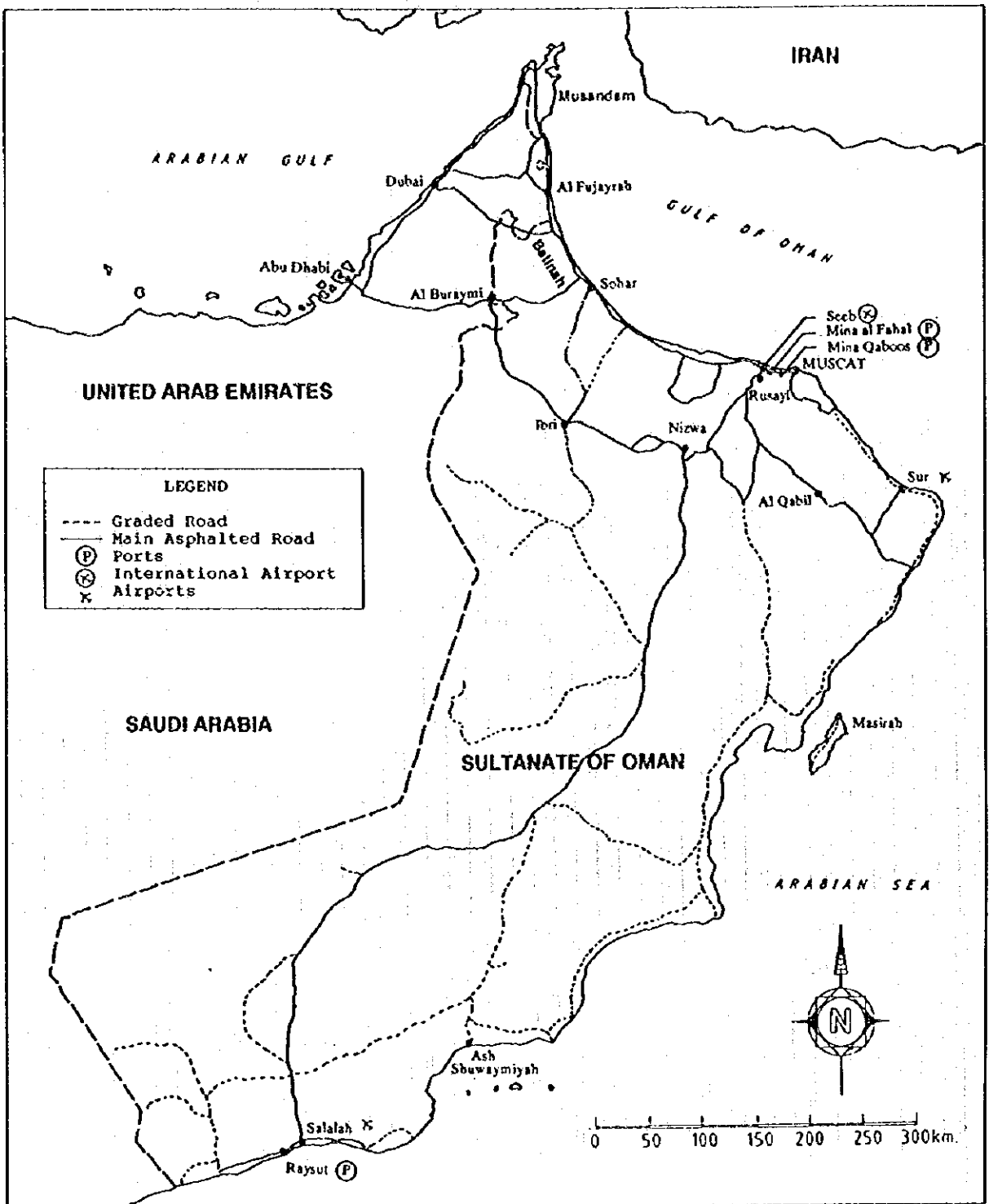


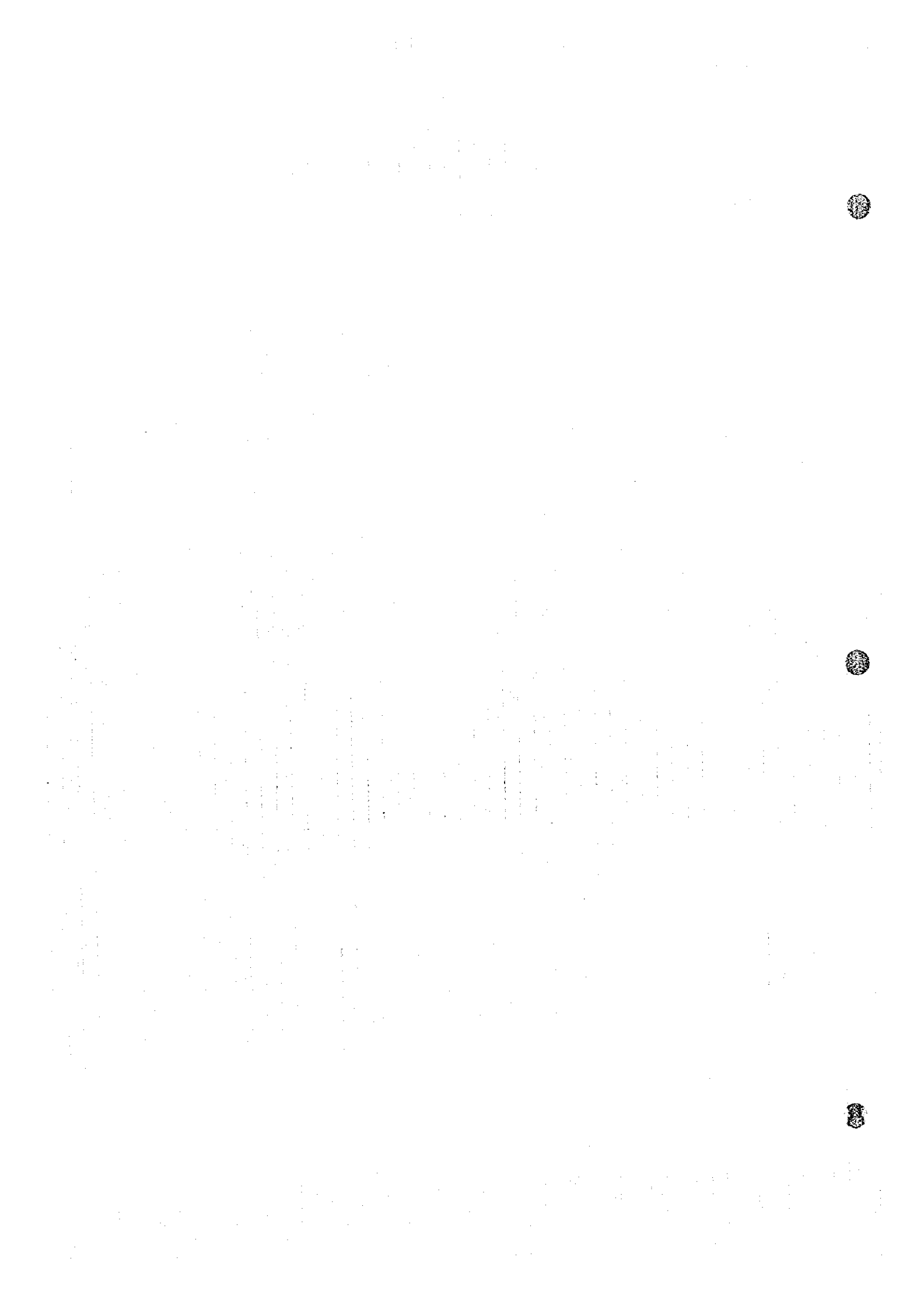
Masayasu Sakanashi  
Team Leader,  
Study on the Establishment of  
Industrial Research Center  
in the Sultanate of Oman





# THE SULTANATE OF OMAN





## Abbreviations

ASEAN	Association of Southeast Asian Nations
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CSF	Common Service Facility
DGSM	Directorate General of Specifications and Measurement, MCI
F/S	Feasibility Study
GCC	Gulf Cooperation Council
GCF	Gross Capital Formation
GDP	Gross Domestic Product
GOIC	Gulf Organization for Industrial Consulting
HS	Harmonized Commodity Description and Coding System
IDD	Industrial Development Department
IRC	Industrial Research Center
IRR	Internal Rate of Return
ISIC	International Standard Industrial Classification
ITMF	International Textile Manufacture Federation
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
MCI	Ministry of Commerce and Industry
MFA	Multi-Fiber Arrangement
MPM	Ministry of Petroleum and Minerals
NAFTA	North American Free Trade Agreement
OCCI	Oman Chamber of Commerce and Industry
OJT	On the Job Training
PEIE	The Public Establishment for Industrial Estate
R&D	Research and Development
RO	Rial Omani
S/W	Scope of Work
SGRF	State General Reserve Fund
SITC	Standard International Trade Classification
SMI	Small and Medium Industry
SQU	Sultan Qaboos University
UAE	United Arab Emirates
US, USA	United States of America
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
PAMAP	The Public Authority for Marketing Agricultural Produce
OEM	Original Equipment Manufacture



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# 1 Background, Objectives, and Scope of the Study

## 1.1 Background

The Ministry of Commerce and Industry (MCI) of the Government of the Sultanate of Oman plans to establish an institution for technical support to industry, named the Industrial Research Center (the Center), as one of the programs which are to be implemented in the Fifth Five-Year Plan, and requested the Government of Japan to provide assistance by Japan International Cooperation Agency (JICA) for the Study on the Establishment of the Center, including investigations on the role and functions of the Center and the designing of its development plan, including the plans for activities, facilities, organization and management, which serves to provide MCI with the basis for preparing the implementation program for the establishment of the Center.

In response to this request, JICA sent a preliminary study mission to Oman in June, 1995 to make a preliminary Study and discuss with MCI the scope of work for the Study. The Scope of Work for the Study was subsequently agreed upon and signed between the JICA mission and MCI, the Government of Oman. Based on the Scope of Work thus agreed, the Study was carried out by a team organized by UNICO International Corporation under the assignment by JICA.

This request was made against the background summarized below.

The Oman economy had substantially expanded, making steady growth up to the middle of the 1980's since the First Five-Year Plan which was launched in 1975, but it tended to stagnate due to the collapse of oil prices after the mid-1980's. The Government has been pursuing the development of non-oil sectors, particularly the mining and manufacturing industry, agriculture and fishery, in order to achieve diversification of the economy and thereby reduce dependence on oil. The industrial output of the non-oil industrial sector has considerably increased, but its weight in the national economy is small as yet.

Because of this situation the Government decided to augment efforts for the furtherance of industrial development, and requested the Government of Japan to provide assistance in preparing the Master Plan for Industrial Development which forms the basis for formulating the Fifth Five-Year Plan to be started in 1996.

In response to this request JICA commenced the Study on Master Plan for Industrial Development in the Sultanate of Oman in October 1993, and presented the final report on

the Study to MCI, the Omani counterpart, in December 1994. The Study recommended several measures and programs to be taken up by the Government for supporting the promotion of industrial development, in which it was recommended to set up an institution which undertakes technical research for the development of products utilizing indigenous resources or fitted to local conditions and also provides technical assistance and guidance for product development as required by the industry in Oman. The idea for the establishment of the Center was derived from that recommendation.

## **1.2 Scope of the Study**

The objective of the Study is to formulate and recommend the plan for the establishment of the Center, which consists of the following two phases:

Phase 1:(1) Identification of the needs for the Center, based on review of the industrial development and analysis of current situation of the industry and future direction of industrial development.

(2) Defining the role and functions of the Center to meet the thus identified needs, the designing of the preliminary development plan for the Center, and investigation on its viability.

Phase 2: Formulation of the detailed plan for the Center based on the preliminary development plan prepared in Phase 1 above.

The scope of the Study set forth in the Scope of Work is cited below.

### ***Phase 1: Conceptual Planning of the Center***

- 1 Brief review of the industrial performance and related to the setting-up of the Center
  - 1-1 Economic performance and development plans
  - 1-2 Industrial performance and development plans
  - 1-3 Domestic, regional, and overseas markets
  
- 2 Analysis of industrial development potentials and directions
  - 2-1 Review of the proposals made by "the Master Plan Study"
  - 2-2 Analysis of business structure and performance of the existing industries including the needs survey on the Center (with a focus on knit and apparel industry)
  - 2-3 Analysis of prospective industries mainly based on domestic resources including the needs survey on the Center (with a focus on gypsum, limestone and kaolin)



- 2-4 Analysis of prospective industries mainly based on locational advantages including the needs survey on the Center (with a focus on packaging and distribution industries)
- 2-5 Analysis of cross-industrial services to promote foreign direct investment and export including the needs survey on the Center (with a focus on information dissemination)\*

(Note)\* To examine such services as required without duplication of those to be provided by the Investment Promotion Center which is to be set up separately.

- 3 Identification of the needs for the Center and clarification of its main functions
  - 3-1 Analysis of the needs for the Center in qualitative and quantitative terms
  - 3-2 Analysis of the possibility to satisfy the needs in terms of technologies
  - 3-3 Analysis of management capability of the Center from institutional as well as human resource aspects
  - 3-4 Clarification of main functions of the Center with due consideration on possible development
- 4 Preliminary development planning of the Center including development and viability study
  - 4-1 Definition of roles and functions of the Center
  - 4-2 Identification of target branch and level of the services of the Center including possible staged development scenarios
  - 4-3 Estimation of space and facilities required
  - 4-4 Development of operation and management system
  - 4-5 Viability study on the Center with due consideration on possible staged development

Phase 2: Detailed Planning of the Center

- 5 Initial set-up
  - 5-1 Institution and organization
  - 5-2 Space and facilities
  - 5-3 Management and technical staff
  - 5-4 Capital raising
  - 5-5 Requirements for international cooperation

## 6 Operations

- 6-1 Target recipients and services
- 6-2 Fees and charges for the services
- 6-3 Systems for improvement of the services
- 6-4 Operating cost
- 6-5 Others

## 7 Possible future expansion

Outline of possible future expansion of target recipients and services in harmony with the initial ones

### 1.3 Outline of Work for the Study

Two field surveys were carried out for the Study with a view to identifying and assessing the needs to be satisfied by the Center and investigating local conditions. A preliminary development plan for the Center was designed on the basis of such needs and conditions, and then the detailed development plan was formulated on the basis of the preliminary plan. Outline of the work carried out in each step of the studies is summarized below.

#### (1) First Field Survey

The main work carried out in the First Field Survey is as follows:

- 1) Review of the economic development plan and industrial development plan proceeding in Oman
- 2) Questionnaire survey on selected existing industries for identifying their needs for improvement of production technologies and facilities and also their needs for technical assistance by public institutions
- 3) On-the-spot factory surveys by the Study Team to identify their needs for technical assistance to be provided by the public institutions
- 4) Discussions with the representatives of the industry to ascertain their interest and reaction to the idea for establishing the Center
- 5) Study on the academic and technical activities in the university and research institutes relevant to industry, testing and research equipment installed in those university and research institutes, and possibilities for utilizing the equipment
- 6) Submission to the Counterpart of an Interim Report containing a preliminary concept of the Center which was drawn up on the basis of the above studies

**(2) Second Field Survey**

The main work carried out in the Second Field Survey is as follow:

- 1) Discussion with the Counterpart with regard to the preliminary concept (such as the role and functions, main fields for technical assistance, institutional structure and framework of overall activities) of the Center, based on the Interim Report submitted to the Counterpart at the end of the First Field Survey
- 2) Discussion with the Counterpart on possibilities for implementation regarding main activities of the Center on the basis of the conceptual design prepared during the First Home-office Work
- 3) Discussion with the representatives of the industry and also with selected firms for the purpose of ascertaining their interest and reaction to those proposed activities
- 4) Supplemental surveys, particularly investigations on local conditions required for designing the detailed plan

**(3) Home-office Work**

Based on the results of the field surveys, the designing of preliminary development plan and detailed plan for the Center and the preparation of a draft final report was carried out at the home office of the Study Team.

**(4) Presentation and discussion of the draft final report, and the preparation of the final report**

JICA Study Team made a series of general reviews and held discussions with the Counterpart with regard to the content of the draft final report in general and then undertook a critical review on the functions, specific activities and management system for the Center in particular. The final report was prepared, based on the conclusion of those discussions.



## **2 Needs for Establishment of Industrial Research Center**

### **2.1 Need for Technical Support from the Viewpoint of Industrial Development Promotion**

#### **[Conclusion]**

From the viewpoint of promoting and fostering industrial development, the needs for technical support are found in the following areas.

#### **(1) Need for strengthening sustainable growth potential of existing industries**

To strengthen sustainable growth potential of existing industries, the following approaches will be pursued:

- 1) Further promotion of import substitution;**
- 2) Development of new applications for already utilized domestic resources;**
- 3) Development of already utilized domestic resources for export purposes; and**
- 4) Improvement and maintenance of competitiveness in export markets by manpower saving, mechanization, and increased value added for existing industries, or competitiveness against imported products.**

The existing industries in Oman are founded upon imported technological resources including production equipment and expatriate engineers. Further, their size of operation is small. As a result, they do not have function to develop and build up their own technology. This means, they have to obtain information from overseas whenever they start a new business, develop a new application, or learn specifications required overseas. Furthermore, technology once introduced is continuously used without internal improvement and soon becomes obsolete to adversely affect competitiveness. Local industries lack resourcefulness to overcome such situation.

Such problem is widely seen particularly in processing type light industries. To ensure their growth potential, therefore, comprehensive support from various fields including technological field is essential.

In the case of process industries such as cement and flour milling, they are operated by relatively large enterprises, each of which has the ability to overcome technical problems through consultation with overseas sources. Nevertheless, they also need technical support in developing new applications and markets since they do not own R&D resources.

#### **(2) Need for promotion of oil and natural gas related industrial subsectors**

So far Oman has produced petroleum products mainly for export purposes. The

fostering of natural gas derivative industries is the one of major challenges in future. Nevertheless, since the oil and natural gas industries have strategic importance for the country and maintain their own sources of technical assistance in various countries, they do not require technical support other than that at present.

(3) Need for promotion of investment in export industries using non-oil-and-gas resources

Other than oil and natural gas, there are no resources in the country which show a high prospect from international standards for various reasons, such as relatively small reserves, the lack of infrastructure to support development projects, or relatively low levels of quality. However, there are several resources which can be commercially exploited if certain conditions are fulfilled. To attract investment in these areas, technical support is required.

[Fields of Particular Emphasis]

- 1) Development of large-scale gypsum mining for export.
- 2) Industries based on gypsum, kaolin and other non-metal minerals produced in Oman (such as gypsum board and plaster, ceramics and other building materials for domestic market and exports).

(4) Need for development or attraction of industries which can take advantage of the country's locational advantages and base on overseas demand

The strategy for development or attraction of such industries include following:

- 1) Development of industries taking advantage in container transportation charges based on a smaller flow of goods from the Middle East compared to the inflow to the region, which would more than compensate for a longer distance to various markets;
- 2) Attraction and promotion of transitional production and trade bases for foreign companies on the country's locational advantages; and
- 3) Fostering of industries which will be effective for attracting the above production and trade bases; which include such industries as packaging and other supporting industries.

Among them, the expected size of industries and enterprises in 1) and 2) is not large as seen from market size and available container volume, and these industries seem to be suitable for development with involvement of a wide range of small light industries. In this case, because of labor supply and demand condition in the country, the development requires those of modern light industries armed with manpower saving and automation technologies and target production of high value added products, rather than labor-

intensive industries. Since a large number of small industries are expected to be involved in this type of project, comprehensive support from various fields including technological field is essential.

**[Fields of Particular Emphasis]**

- a) Food industries for exports
- b) Repackaging/re-export industries
- c) Packaging industry related to the above industries

**(5) Need for employment promotion of Omani people by the industrial sector**

Employment of local people by the industrial sector is very limited, and most of managers, engineers and workers are expatriates. Although various programs are in place to provide education and training for local people to work in the industrial sector, existing training does not allow trainees to obtain high levels of technical skills to find employment. Given the anticipated increase in younger population, imminent slowdown in employment growth in traditional employers of indigenous people, e.g., the government, military, and financial industry, and the need for local labor force having expertise and skills in industrial technology as the basis of economic diversification in the future, there is a strong need for effective support to create employment opportunities in the industrial sector.

The above policy direction is in line with industrial development policies and strategies which are summarized as follows.

(1) In Oman, the oil sector has been playing a critical role in the country's economic development. In future, the country will continue to depend much on the oil and natural gas sector. At the same time, recent economic downturns due to limited petroleum production and sluggish oil prices suggest that future economic development must come from non-oil sectors. In this recognition, the government has announced its new economic development policy "to encourage diversification of the economic structure, while maintaining sustainable growth, and thereby to reduce dependency on oil and establish a stable foundation of future economic growth." Diversification of the economic structure seems to represent a large hope for significant growth of the industrial sector.

(2) In fact, the industrial sector has been rapidly expanding over the past two decades and has become the largest non-oil productive sector. It is difficult, however, to expect sustainable growth of the industrial sector at the past pace for various reasons:

- 1) the past industrialization process was driven by import substitution, and now a room for further substitution is limited;
- 2) the current level of industrial accumulation is far less than satisfaction, and the existing industries rely on imported materials and have not formed much inter-industrial linkage, so that the industry sector does not have the ability to create much domestic demand;
- 3) fairly small population limits consumer demand.

(3) Under these circumstances, the current strategic focus of industrial development is being placed on building the industrial foundation, thus the level of industrial accumulation, by leveraging all the opportunities for industrial development. After that, industrial deepening through development of inter-industrial linkage will be pursued. Following is the development area to be pursued with this strategy:

- 1) Continuation of industrial promotion strategy as seen in the past:
  - a) To sustain and rev up the existing industries which mostly serve the domestic market through:
    1. through accelerated export promotion,
    2. strengthening of competitiveness against imported products, and
    3. strengthening of competitiveness of existing export industries, and
  - b) To further promote import substitution-based industrialization.
- 2) Promotion of the oil and natural gas based industry
- 3) Industrial development exploiting non-oil natural resources which are available in certain quantities
- 4) Industrial promotion oriented to foreign markets to supplement the small domestic market:
  - a) Attraction and promotion of industries which form part of or support transitional production and trade bases by relying on Oman's locational advantages;
  - b) Promotion of export industries which can capitalize on locational advantages and other favorable business environment in Oman.

(4) In addition, the government has high expectation for growth of the industrial sector as the means to expand and diversify employment opportunities for local citizens. Increased employment in the industrial sector is expected in view that it will create labor force having expertise and skills, which will form the foundation of new development for the national economy.



*An outline of the economic development and performance, and industrial development plan in Oman is given in Annex 1 (Outline of Economic Development and Industrial Development Plan in Oman). With reference to Annex 1, this Chapter reviews the role of industrial development in the economic development in Oman.*

## 2.1.1 Role of Industrial Development in Economic Development

### (1) Contribution to economic growth

Oman started the Fifth Five-Year Plan in 1996 after having experienced three Five-Year Plans following the First Five-Year Plan which started in 1975, and continued steady development of the economy over these two decades. Particularly up to the middle of 1980's, the economy achieved conspicuous growth, as oil revenue increased annually. However, the economic growth recently tended to stagnate due to the fall of oil prices.

The Government intensively promoted the development of the non-oil sector, particularly mining and manufacturing industry, agriculture and fisheries, for pursuing diversification of economic structure and thereby reducing dependence on oil. The manufacturing industry as well as mining (excluding oil and gas) grew rapidly in 1980's. Manufacturing industry sustained steady growth up to the present, although it has been slowing down in recent years. The weight of the manufacturing industry, however, is still low in the economy despite such substantial growth.

### Indicators Showing Growth and Structural Change of the Economy

	Annual Average Growth of GDP in Real Terms (%)			Percentage of GDP in Nominal Terms		
	1980-90	1990-94	1980-94	1980	1990	1994
	Oil and Gas Sector	8.1	4.3	7.0	61.5	48.1
Non-oil Sector	8.8	6.5	8.1	38.5	51.9	63.4
(Mining)	(24.6)	(7.5)	(19.4)	(0.1)	(0.3)	(0.3)
(Manufacturing)	(23.7)	(8.5)	(19.2)	(0.8)	(3.7)	(5.2)
(Agriculture & Fisheries)	(7.1)	(3.0)	(5.9)	(0.3)	(3.2)	(3.3)
GDP	9.1	5.5	8.1	100.0	100.0	100.0

The manufacturing and mining (excluding oil and gas) as well as fishery industries are important sectors for accelerating diversification of the economy, particularly through the development of non-oil income generating industries, since agricultural production appears

to hardly be capable of sustaining substantial growth in future. Diversification of the economy through intensive development of these sectors would be essential for sustaining steady growth of the economy. Particularly, emphasis will be placed on the development of the manufacturing industry, since it is the most vigorously growing sector.

(2) Contribution to exports

The overwhelming majority of Oman's export income is from oil, accounting for 96% of total export value in 1980. Dominance by oil exports led to instability in the total exports, as it was affected by volatility in the international oil market. The non-oil exports and re-exports have been steadily increasing after 1985, gradually rising in terms of their share in total exports.

Trend of Non-oil Exports and Re-exports (in Value Terms)

	<u>Annual Average Growth (%)</u>	<u>Percentage of Total Exports</u>		
	(1985 - 1994)	<u>1985</u>	<u>1990</u>	<u>1994</u>
Oil	- 0.2	93.2	91.7	76.4
Non-oil exports	22.7	1.3	4.3	6.8
Re-exports	15.6	5.5	5.0	16.8
Total Exports	2.0	100.0	100.0	100.0

Manufactured exports accounted for about 39% of non-oil exports in 1994, in which the largest export item is garments, accounting for 46% of the manufactured exports, followed by processed food accounting for about 18%. The exports of mineral and metal products, and the exports of agricultural produce and meat account for 33% and 28% of the non-oil exports respectively.

Oman recorded a visible trade surplus every year, but the trade surplus has been narrowing due to imports increasing at a higher rate than the growth of exports in recent years. It is likely that the imports will continue to increase along with increasing demand for food and consumer goods as well as capital goods. In order to maintain the trade surplus, the growth of exports is vital. As it appears difficult to increase oil export earnings because of limits to crude oil production and a downward trend in international oil prices, emphasis will be placed on increases in non-oil exports and re-exports. Particularly the development of export-oriented manufacturing industry should be of more importance, since the exports of mineral and metal products, agricultural produce and meat are hardly to increase.

### (3) Importance of industrial sector in the economic development plan

As described above, the industrial sector has steadily expanded over the last two decades in line with the Government policy calling for reduction of dependence on oil in the economy through the diversification of economic structure, and thus at present it is the greatest sector in the non-oil productive sector in terms of contribution to the economic growth as well as to non-oil exports. Despite such significant growth, however, the weight of this sector is as yet low in the economy. It is obvious that the further development of industry is the most important task in the economic development plan which pursues the diversification of economic structure as well as sustained economic growth.

According to "Vision for Oman's Economy towards the Year 2020" announced by the Government, the national target is to double the gross national income by 2020 while maintaining the monetary value of Oman Rial, so that Omani per capita income can be maintained at least at the 1994 level of RO. 2,093 (or US\$ 5,440) in real terms, and indicates the guideline for the macroeconomic policy for achieving this target, as follows:

- 1) Sustainable development based on a stable macroeconomic framework
- 2) Establishment of diversified, dynamic and globalized economic structure
- 3) Advancement of human resource development
- 4) Fostering of efficiency and competitiveness of the private sector

It emphasizes the importance of the following principles in the development plans:

- 1) Reduce dependence on oil by widening the economic infrastructure and diversifying.
- 2) Pay more attention to the conservation of natural resources, and proceed with development in due consideration of the preservation and efficient use of natural resources and also attaining balance between area and population in a manner which is appropriate to the regional distribution and the availability of natural resources with due regard to the importance of realization of higher rates of self-sufficiency in basic products and the preservation of non-renewable resources.

To achieve the foregoing development goal, the economic development policy calls for increased the contribution to GDP made by the non-oil income generating sectors, particularly agriculture, fisheries, manufacturing, tourism and service sectors, through increased investment as well as through the expansion of industrial infrastructure, while extending the recoverable life of oil reserves, thereby pursuing the restructuring of the economy. Industrial development will play a more important role for pursuing 1) the diversification of economic structure and widening of the economic base by generating

national income from non-oil sources and increasing non-oil domestic production, and also for 2) expanding non-oil exports.

The Government also adopted the policy of pursuit of the creation of employment opportunities for the nation's workers and the realization of Omanization in order to create employment opportunities for the increasing generation of young Omani people. Industrial development will play an important role for this issue as well.

## **2.1.2 Basic Strategy and Promotion Policy for Industrial Development**

### **2.1.2.1 Macro-target for Industrial Development**

The long-term economic development policy has as its target to sustain the economic growth at an average of not less than 5% per annum in real terms. It is foreseen that the growth of sectoral value-added in the oil sector will slow down, as international oil prices are unlikely to rise in as conspicuous upward trend, although the Government has a policy for oil production that is to maintain the present level of around 700,000 BBLD in the future. When the development of currently discovered huge-scale gas fields is realized, the sectoral value-added will increase to some extent with increases in gas production. Even with increases in the gas sector, nonetheless, the growth of the sectoral value-added in the oil sector will be hardly more than 4% per annum.

Under these conditions, the growth of non-oil sectors should be of vital importance for achieving the economic growth target. Particularly, the manufacturing industry is required to maintain its growth at more than 13% per annum in nominal terms, and hence the promotion of industrial development is a vital task.

The scale of the existing manufacturing industry, however, is far below the scale needed to achieve this growth target. Thus, in order to achieve this goal, while furthering the sustained growth and expansion of the existing industries, it should be important to accelerate new industrial investments by identifying investment opportunities in a wider scope of industries to promote and encourage industrial investment, particularly by the domestic private capital as well as foreign capital.

### **2.1.2.2 Basic Strategy**

In view of Oman's given conditions that the size of domestic market is comparatively small and further that the natural resources available in the country are inadequate in terms of variety and reserves to cater for sustaining steady growth of the economy for long, it is

vital to develop both resource and non-resource based industries, and sustainable growth of these industries should be based not only on the domestic market but also on overseas markets. Considering the effective utilization of Oman's geographic advantage, the future vision for industrial development envisages to develop Oman so as to take a position as an "International Industrial and Trade Center in the Mid-East Region" where regional operation centers, technical service centers and distribution centers as well as an export processing zone are located, so that those centers located in Oman and other foreign-owned establishments located in the export processing zone will create domestic demand for industrial products and industrial services and also bring those demands for the overseas markets as well.

However, Oman lacks the technological and managerial basis which is indispensable in exploring the full potential of its geographical advantages.

Further, Dubai in UAE is situated in an advanced position in terms of industrialization as well as economic development based on the above-mentioned considerations. There are a number of foreign investments in the Free Zone, including regional centers operated by multi-national companies, and production bases of foreign operators for their export or re-export business. Further, Dubai is the hub of ocean container lines whereas the Muscat port and other ports in the Gulf are feeder ports.

In recognition of this situation Oman will take a position supplementing Dubai's function at the initial stage, and then grow to a sub-center in the region that can share a more significant position with Dubai along with meeting increasing regional demands for such an industrial location. With this development step, Oman in the future will establish its position as the regional center standing side by side with Dubai.

In order to establish Oman's position as an "International Industrial and Trade Center in the Mid-East Region", Oman should develop the following functional industries:

- 1) Distribution functions: ocean transport lines, ocean container lines, bulk transport system, general cargo ocean transport system, freight forwarders, bulk storage, cold storage, common warehouses, etc.
- 2) Precision engineering functions: manufacturing of machine tool and machinery components, metalworking, etc.
- 3) International communication functions: computer networking, printing, packaging, advertising, warehousing and distribution, and legislation for the protection of intelligent property, etc.

- 4) General supporting functions: industrial design, automation, packaging, metal stamping, plastic processing, tool and die manufacturing, etc.
- 5) Research and testing functions: standards-related tests, applied research on manufacturing technologies, standard development, etc.

The existing functions in Oman are only a few among the foregoing functional industries. Given the present situation of industry with its limited fields and low number of establishments, however, it would not be realistic for Oman to contemplate the establishment of those functional industries within a short period of time. Thus, in order to promote industrial accumulation with efficient utilization of the limited resources available and limited markets, Oman, as the immediate task for development, will focus on upgrading and strengthening the existing industries for sustainable growth, as well as the promotion of industrial investment, particularly private investment, to establish new industries that will cater to both the domestic and export markets.

Taking these development steps will entail the creation of markets for industrial inputs including raw materials, intermediates, and supporting services required by the newly established industries. Thus, along with this evolution, the future tasks will be directed to the development of upstream industries and supporting industries, while continuing the expansion of established industries.

Through the aforementioned development steps, Oman's manufacturing industries will be built up with competitiveness and efficiency towards diversification of industrial structure and deepening of the industrial base in the future. In Oman, however, the demand actually generated from such industry will not be sufficient for development of upstream industry and supporting industries due to the limited scale of downstream industries. Hence the development of upstream industries and supporting industries should also depend partly (often mostly) on the demand from abroad, including exports to overseas markets, while some elements should be met by imports because some of the supporting industries or upstream industries are still unfeasible for Oman. Thus, in Oman the deepening of industry will be pursued on a selective basis, focusing on the sub-sectors essential for realizing the future vision of industrial development.

In order to pursue the promotion of industrial development in line with the foregoing development scenario, the basic strategy will pay attention to the four basic directions enumerated below.

- (1) Industrialization with close linkage to industrial capital in foreign countries and based on overseas markets

Up to the present, Oman has been pursuing industrialization mainly for import substitution in the domestic market. The overwhelming majority of the existing industry is based on the domestic market, except the garment industry which is the only exceptional case that has been developed entirely for export trade from the initial stage.

For the promotion of further industrial development, emphasis will be given to the following:

- 1) Promotion of export industries based on promising resources available in Oman, and also those having comparative advantages derived from geographic advantages and other favorable business conditions existing in Oman
- 2) Promotion of industries which can serve foreign industries as their production base or distribution base for re-exports or regional distribution

- (2) Selective promotion of local supply industries led by the development of the relevant market and usage for selected products

Selective development will be promoted in the following fields of industries:

- 1) Industries which can be developed for local supply if intensive efforts are devoted to the development of local markets, particularly new industrial products (including final consumer goods and also industrial inputs such as packaging containers and components to be used by other industries) which are not present yet in Oman, but have potential for growth on the basis of increasing demand in future.
- 2) Existing industries using indigenous resources which have possibilities for product diversification for more efficient use of those resources with the development of markets and usage
- 3) Industries for producing new products with market development which will lead to the utilization of resources not utilized yet

- (3) Simultaneous promotion of large-scale resource-based export industries and small- and medium-scale light industries (particularly manpower saving with mechanization and production of higher value-added products)

Intensive promotion efforts will be devoted to develop large-scale resource-based export industries such as natural-gas based petrochemical and hydrocarbon industry (ammonia/urea, methanol, etc.) and large-scale mining of gypsum for export. However, these projects, once developed, will hardly induce subsequent development of other projects because of their individually self-dependent nature and also of the limited

availability of resources used. Hence, sustainable growth of industry could not be achieved only with the development of large-scale resource-based export industries. Thus, efforts will be made simultaneously for promoting the development of a wide variety of small- and medium-scale light industries based on the foregoing strategy (1). For this development, emphasis will be placed on the development of modern light industries, rather than labor-intensive light industries, including the rationalization and diversification of the existing industries to achieve manpower saving with mechanization and diversification towards higher value-added product lines, for the labor-intensive light industries have disadvantage in cost competitiveness due to the particular situation in Oman where the industries would be dependent on expatriate labor forces.

(4) Undertaking of overall support by the Government for the promotion of industrial development

In promoting the industrial development in the foregoing strategy, the Government will promote the development of industries by the private sector, except large projects for which the Government will take the initiative, since the development of large projects are hard for the private sector to promote. To promote the development of industries by the private sector, the Government will undertake overall support for assisting the development efforts by the private sector, particularly with investment promotion (especially to attract foreign investment), enhancement of the industrial finance system, human resources development, the establishment of technological bases, and the upgrading of industrial infrastructure, and also will take necessary steps for stimulating industrial development and building up a balanced industrial structure towards realization of the Future Vision.

**2.1.2.3 Main Industries Given Priority for Immediate Promotion of Development**

The main industries given priority for pursuing the promotion of industrial development based on the foregoing target, scenario and strategy are enumerated below.

(1) Stimulating the growth of existing industries which will contribute to immediate growth of the industrial sector as well as forming the industrial base for further advance. These industries include the following:

- 1) Industries producing goods which are directly encouraged by public investment and its indirect effect (such as cement, aggregates, and other construction materials)
- 2) Industries which can increase their production with the aid of marketing efforts for exports (such as oil, cement and processed foods for exports to GCC markets)



- 3) Enhancement of the existing export industries (garment industry and marble industry for exports)
- (2) Promotion of the development of large-scale chemical projects such as natural-gas based petrochemical and fertilizer projects in association with the development of new large-scale gas fields and the development of LNG/LPG projects for exports.
- (3) Promotion of the development of large-scale gypsum mining for export.
- (4) Research and promotion for the development of industries based on gypsum, kaolin and other non-metal minerals produced in Oman (such as gypsum board and plaster, ceramics and other building materials for domestic market and exports)
- (5) Promotion of the development of industries based on geographic advantages of Oman. These industries include the following:
  - 1) Manufacturing of high-value knitwear for exports using cotton or blended yarns imported from India and other neighboring countries.
  - 2) Producing snack foods and other processed foods for domestic and export markets by using agricultural products imported in bulk from neighboring countries.
  - 3) Undertaking of the re-packing of medicines and agricultural products imported for re-export.
  - 4) Development of the relevant industries supporting the foregoing industries which can supply essential inputs, including high quality packaging containers and printing.

#### **2.1.2.4 Government Measures for Supporting the Promotion of Industrial Development**

In order to promote the industrial development as mentioned above, the Government will undertake the government supports for the following measures:

- 1) Promotion of export
- 2) Promotion of foreign investment
- 3) Enhancement of the financial system for industrial development
- 4) Human resources development
- 5) Establishment of technological bases
- 6) Improvement and expansion of infrastructure

The industrial development center is planned as part of such comprehensive government support activities and will focus on support in 5) above. In addition, it will

provide technical support in other areas. In particular, it will be closely associated with 1), 2), and 4), and functional division with related organizations is discussed in 3.1.3.

To provide support in 1) and 2), an organization responsible for export promotion as well as investment promotion will be established under MCI and is currently at an actual planning stage. Support in 3) is already provided by various incentive programs for industrial investment under MCI and ODB's loan program, suitable for business development and export projects of traditional size. To meet large investment projects and those involving foreign investors, such as natural gas projects, new mechanisms to recirculate capital in Oman and other Middle East countries are planned or have started.

As for support in 4), despite the upgrading of the vocational training system, employment opportunities for local people in the industrial sector have not increased notably. A further progress seems to be difficult through the improvement of the general education and training system, and it is time to launch diverse and comprehensive efforts including the center's activity.

### **2.1.3 Need for Technical Support for Promotion of Industrial Development**

As part of government's supportive measures to promote industrial development as mentioned above, various types of technical support are required in the context of industrial development strategy. On the other hand, the needs for technical support in overall promotion of industrial developed seem to lie in the following areas. It should be noted, however, that petroleum and gas resource development - one direction of the above development strategy - is a national strategic area and will be proceeded by using the sector's own relations with foreign investors and technology sources. At present, therefore, it does not need technical support to be provided by the center.

#### **(1) Need for strengthening sustainable growth of existing industries**

The successful industrialization process in Oman depends in part on strengthening of sustainable growth potential of existing industries. As discussed in 2.2, existing industries in Oman has many problems. In particular, SMEs lack adequate management and technical capabilities which need to be reinforced by comprehensive supportive measures including technical support.

Most of Oman's industries, however, have been established only recently, and operate manufacturing units acquired from abroad while using expatriate supervisors and operators.

This situation limits the accumulation of technologies as well as upgrading of management capabilities in individual manufacturing enterprises.

Most manufacturers, at present, undertake the production of customary products employing commonly established process technologies transferred from abroad or based on product designs provided by foreign partners or buyers. Thus, the present level of production can be sustained even without accumulation and upgrading of technologies. As Oman has adopted a free trade and free market policy, however, the domestic industries should have adequate capability to sustain themselves in free competition with imports, and therefore should pay continuous efforts to keeping ability to sustain continuous growth by taking necessary measures for enhancement of competitiveness, such as improvement and diversification of products and improvement of product quality and productivity. At the same time, the export industries should also pay more effort to strengthening export competitiveness, since the existing export industries in Oman do not necessarily have strong comparative advantages.

For Oman, possessing a relatively small domestic market, the development of competitive export industries is vital for promoting industrial development as well as expanding non-oil exports. Toward this end information, regarding export products and technologies appropriate for manufacturing exportable products, as well as regarding export markets, are important tools. In Oman, however, many enterprises lack such information. On the other hand, collection of such information needs group activities to minimize costs and also the establishment of a network with external information sources. In the early stages of export development, it is important to provide enterprises with governmental assistance for export product development and marketing abroad.

There are many opportunities to start export manufacturing, and there are some examples of success; for example export of dates as raw materials for special sauce, export of vegetables to Japan by air cargo, etc. However, much of the seeds of export manufacturing have been hampered by lack of knowledge about the needs of markets, difficulty of access to the export market, lack of knowledge on packaging, and/or poor performance at the initial contact with potential buyers.

From this viewpoint, MCI is going to set up a public institution undertaking export promotion, named "Investment and Export Promotion Center", while an export marketing company has been established under the MCI's initiative and with joint investment by leading member firms of OCCI, and is active in marketing. However, no public institution

which undertake market intelligence service and product development assistance exist in Oman. The services available from the aforesaid "Investment and Export Promotion Center" will be limited to general information on the export market, and the information for specific products will be hard to obtain. In order to promote the development of specific export industries, it is indispensable to provide enterprises with technical assistance for product development as well as gathering and supplying of technical information and marketing information related to such industries.

(2) Need for the development of new industrial projects

The basic strategy for industrial development lays emphasis on the promotion of industrialization with close linkage to industrial capital in foreign countries and based on overseas markets, focusing on the following areas:

- 1) Promotion of export industries based on promising resources available in Oman, and also those having comparative advantages derived from geographic advantages and other favorable business conditions existing in Oman
- 2) Promotion of industries which can serve foreign industries as their production base or distribution base for re-export or regional distribution

1) Need for technical support for development of new resource based-projects

The following are the industries to be given attention for the development of resource-based exports:

- a) Large-scale chemical projects such as natural-gas based petrochemical and fertilizer projects in association with the development of new large-scale gas fields and the development of LNG/LPG export projects.
- b) Project for the development of large-scale gypsum mining for export.
- c) Industries based on gypsum, kaolin and other non-metal minerals produced in Oman (such as gypsum board and plaster, ceramics and other building materials for domestic market and exports).

In order to promote and encourage new investment by both domestic private capital and foreign capital for those projects, it is effective to produce information regarding prospective mineral resources, particularly in respect of recoverable reserves, composition and suitability for industrial raw materials, and provide such information to potential investors who show interest in those projects. The Ministry of Petroleum and Minerals (MPM) is responsible for the study of such resources, and has basic data and information regarding those resources. The objective of MPM's exploration work, however, is principally to confirm the reserves of oil, natural gas and other minerals,

and MPM has carried out no further steps of exploration work except for oil and gas. Hence regarding minerals yet unutilized, particularly gypsum, kaolin and other minerals to be used as raw materials for manufacturing ceramics and building materials, no study has been carried out for evaluating suitability of those minerals as raw materials. In order to provide potential investors with such information, application research on specific minerals, including the evaluation of suitability for raw materials, should be carried out by a public research institute, but no such institute exists in Oman.

2) Need for technical support for development of projects based on locational advantage of Oman

For the development of industries based on geographic advantages of Oman, emphasis is given to such industries as enumerated below.

- a) Manufacturing of high-value knitwear for export using cotton or blended yarns imported from India and other neighboring countries.
- b) Producing snack foods and other processed foods for the domestic and export markets by using agricultural products imported in bulk from neighboring countries.
- c) Undertaking of the re-packing of medicines and agricultural products imported for re-export.

In order to develop these industries, it is important to develop relevant supporting industries, including those supplying high quality packaging containers for export goods and printing of export-grade packaging containers. However, as the existing industries are inferior in packaging technology, it is important to provide those industries with technical guidance for improvement of packaging and dissemination of information on latest packaging technology for upgrading and raising their knowledge and awareness on packaging.

(3) Technical support for promoting the employment of Omani work forces in the industrial sector

The creation of employment opportunities for Omani work forces and pursuance of Omanization are important tasks in the national development plan, and the Government has been implementing several programs for the promotion of Omanization. These include upgrading of technical and engineering departments in the university, technical colleges and vocational training schools to develop Omani engineers and technicians, and provision of tax incentives or training subsidies to industrial enterprises employing Omani workers, thereby encouraging the employment of Omani workers by the enterprises.

Large state-owned enterprises have hired Omani work forces and trained them in line with the national policy, and therefore the rate of Omanization is high in those enterprises. In contrast to this, private enterprises are still reluctant to employ Omani engineers and workers because of their less experience and lower work efficiency compared to expatriates, since the private employers prefer to use expatriate engineers and workers who are readily workable because they undertake labor-intensive operations relying on workers' skill and efficiency.

Nurturing the national human resources who are capable of assimilating and accumulating transferred technologies is vital for the industries to accumulate and improve technologies. For this end it is essential to upgrade the education and training systems in the university, technical colleges and vocational training centers, to develop human resources who have appropriate education and training for working in small- and medium-scale industries in the private sector, and also to provide enterprises with technical support for their training of Omani employees and also for adopting production systems which can be operated by Omani workers.

## **2.2 Need for Technical Support Required by Existing Industries and Enterprises**

### **[Conclusion]**

The need for technical support by existing industries and enterprises is relatively small, excepting some specific industrial areas. Industries which urgently need technical support are those exporting or intending to export their products.

Details are as follows.

Almost all of technologies used in the existing industries in Oman have been transferred from abroad.

Apparently, the selection of appropriate technologies, which is one of the key factors for the successful technology inducement, has also been undertaken without causing significant problems. Also, industries who urgently need the improvement or modification of existing technology introduced from overseas are limited to those exporting or planing to export their products, for the following reasons. Technologies transferred to Oman have been selected in consideration of the limitations prevalent, and the industrial development peculiar to the country, namely 1) a small domestic market, 2) necessity to import most raw materials and component parts due to lack of supporting industries, and 3) availability of skilled labor from abroad at relatively low costs. The existing process-plants adopt

relatively modern technologies, although most of those plants are smaller in production scale than the internationally standard. As a result, they can effectively compete in the domestic market. On the other hand, the small- and medium-scale light processing industries mostly adopt conventional labor-intensive production systems. Such production is essentially weak in sustaining competitiveness in international markets. In Oman, however, as industrialization is still at an early stage and the majority of the existing industries undertake the import substitution in a limited field of industries, they faced few problems in selection and application of technology for their operation.

The major export-oriented industry is the garment industry. The industry require full-scale support including technical support.

The export garment industry in Oman primarily exports to the United States, where competition with exports from other countries is becoming more and more serious. At present, as Oman still has some unfulfilled portion in its quota, orders are placed to the Omani garment manufacturers. However, as the export garment industry in Oman is essentially weak in cost competitiveness, the industry may become unable to sustain export competitiveness. The survival of the industry must be pursued through enhancement of cost competitiveness and diversification of products, improvement of quality, improvement of productivity by mechanization, upgrading and rationalization of production systems, as well as diversification of export markets.

In the food processing industry which is about enter into the export market, the need for technical support is becoming apparent in some areas. The industry has been traditionally serving the domestic market with some exports to neighboring countries. In the case of the food processing and beverages industry, enterprises trying to export their products to the markets other than the neighboring countries, they face the need to improve products, quality and productivity. Particularly the improvement of packaging is the most important task for them. Many enterprises engaged in production only for domestic market, however, have no awareness of the value of packaging. As enterprises launching on an export campaign or manufacturing of new types of processed food increase, the need for improvement of packaging as well as improvement of products and quality will rise.

The need for technical support in other industries is fairly small.

Most industries have been using technology and equipment imported from foreign countries and are mainly serving the domestic market, facing the situation mentioned earlier. Such industries include the textile industry, the garment industry serving the domestic market, the woodcraft and furniture industry, the paper and paper product

industry, the printing industry, the chemical and chemical product industry, the non-metallic mineral product industry, and the metal and machinery industry.

*The current situation of the existing industry in Oman is described in more detail in Annex 2. With reference to Annex 2, this section analyzes the needs for technical support required by the existing industries/enterprises.*

### **2.2.1 Current Situation of Manufacturing Industry in Oman**

Most of the manufacturing industry existing in Oman is small- and medium-scale industry and micro industry. The existing large-scale industry is very limited, such as a petroleum refinery, a copper smelting plant, cement plants, and a flour mill, which were constructed under the government initiative from the late 1970's until the mid-1980's. The main light industry includes food and beverages, woodworking and wood furniture, textile and apparel, paper and paper products, printing, plastic processing, non-metal mineral products and metalworking and machinery.

More than 3,000 enterprises are registered in the Ministry of Commerce and Industry (MCI). Among various subsectors, the food processing industry and garment industry are comprised of a relatively large number of large- or medium-scale enterprises. As the domestic market is limited, some enterprises in the food processing industry export part of products to GCC countries, and some other enterprises are trying to shift their production towards exports. The garment industry has rapidly expanded since 1989, while being totally oriented to export trades, and it comprising more than 30 enterprises, is the largest export industry in Oman. Most of them are engaged in the manufacturing of garments to be exported for the low-end market in US, by producing on the basis of design provided by buyers and according to their orders. The marine products processing industry also has developed while having an export orientation, but there are only a few enterprises engaged in this industry. Other existing industries are mainly for domestic markets, although some enterprises export part of their products to GCC markets and other markets abroad.

A large number of enterprises are engaged in three industries, i.e., non-metal mineral products industry, woodworking industry, and metalworking and machinery industry, but small and micro enterprises dominate with an overwhelming majority. The majority of enterprises in the non-metal mineral products industry are engaged in the production of construction and building materials, such as aggregate, bricks and concrete blocks, etc. The woodworking industry consists mainly of sawing and furniture making. While there



are a few large furniture makers which manufacture high-grade furniture based on advanced technology and design acquired from Europe, the majority of companies in this industry are small and micro enterprises which undertake the manufacturing of furniture mainly by manual work. The majority of enterprises engaged in the metalworking and machinery industry also are small- and micro-scale, and only a few are large enterprises. The main business of large enterprises in this industry is the fabrication and repair of equipment and machinery for the oil industry, particularly for PDO and ORC. Small and micro metalworking enterprises undertake the fabrication of steel structures, or the manufacturing of metal furniture, metal appliances, metal fittings and hardware with plating, welding and simple machining. In Oman, industry assembling electric and electronic machinery, and the precision machinery components industry have not emerged due to the small domestic market.

(The current situation of the main industrial branches are described in more details in Annex 2.)

### **2.2.2 Underlying Management and Technical Problems in the Existing Industry**

Under the current situation of the existing industries as described above, management and technical problems encountered by the industrial enterprises are different depending on the size and type of operation. These problems are enumerated below by classifying industry into three groups: large process-plant, large- and medium-scale light processing, and small and micro.

#### **(1) Large process-plant based industry**

Large process-plant based industry is represented by the petroleum refinery, copper smelting plant, cement plant and flour mill. They adopt internationally applicable advanced process technologies and equipment and have an economic production scale, and thus encounter no particular technical difficulty. However, most of these large plants, except the petroleum refinery, have fallen to low capacity utilization due to the small domestic market and keen competition in the GCC markets which have been the major markets for Omani exports.

#### **(2) Large- and medium-scale light processing industry**

The large- and medium-scale light processing industry, which accounts for main part of the existing industry in Oman, broadly consists of (1) import-substituting industries,

including food processing and beverages industry, furniture industry, building materials industry, metalworking and machinery industry, paper products industry, printing industry, plastic processing industry and other industries producing various consumers' goods, and (2) garment industry which has developed as an export industry. These problems two groups encounter are partly in common and partly different in nature, and thus the underlying problems are distinctive for each group.

Enterprises engaged in the import-substituting industry operate manufacturing facilities based on technology and equipment acquired from abroad and by employing managers and workers employed from neighboring countries. Most of these manufacturing enterprises depend on expatriates who manager the factories. The national entrepreneurs and managers who have experience in industrial management are still limited in number. Under these conditions, enterprises can hardly build up reliable management systems and skills and marketing know-how. Thus most of the enterprises are weak in technology accumulation and management capability, so that they are vulnerable to any adverse change in the business climate. As most raw materials are imported, the raw material costs are relatively high, causing loss of competitive power.

In particular the metal fabrication and assembly industry in Oman is still at an early stage of development. Most of the existing metal fabrication and assembly works use raw materials, intermediates and major components imported from abroad. These works are equipped with small-size machinery and undertake a variety of metal fabrication works requiring a low level of precision, on the basis of job orders small in scale. Hence, their productivity is poor. Captive markets for these industries are related to the oil and gas exploitation work and petroleum refinery, but there exists no assembly industry represented by electric, electronics and automobile industries which require a high level of quality and production control.

In the food processing and beverage industry and other some industries, there are some enterprises which export part of their products to GCC countries and other markets abroad, and in recent years some have tried to shift their main business to exports due to limited growth in the domestic market. Those enterprises encounter problems of product quality and cost competitiveness and also of packaging. In Oman, as there exists no industry which can produce high quality packaging materials, package user industries use either inferior or average grade packaging containers locally produced or make their own. The packaging containers used by them, except only a few of the large enterprises, are inferior in material quality, design and manner of packaging, and most do not unsatisfy importers'

requirements. If high-grade packaging containers are imported to meet such requirements, it would cause substantial increases in packaging costs, resulting in loss of price competitiveness. Hence the improvement of packaging is a serious problem for exporting enterprises to solve.

Garment manufacturers undertake the production of garments specified by buyers with their design and on the basis of their orders. They employ experienced expatriate managers and supervisors, and also use expatriate workers for all processing steps, including pattern making, marking, cloth cutting, sewing and stitching, and finishing. Fabrics and other supplies are imported, and the manufacturing is based on a conventional labor-intensive production system. Wages paid to expatriate workers are substantially higher than those paid in the south-west Asian countries, but labor productivity is comparatively high because most of expatriate workers employed in Oman are skilled and work with high efficiency. Nevertheless, as long as the operation is dependent on expatriate workers, the labor-intensive production is essentially costly, and hence export industries in particular are disadvantageous in competition with those in neighboring countries where cheap labor is abundantly available. As sale of the garment exports from Oman are concentrated in the US market and, furthermore, main products are low-grade items for the low-end market there, the manufacturers face keen competition and have to accept low value-added.

### (3) Small and micro industry

Small enterprises and micro-enterprises, while dominantly large in number, constitute local industries producing general goods by using traditional manual techniques on a small-lot contract basis. While some one-man shops are operated by local people, most of small shops employing a few workers are operated by foreign craftsmen who have come from neighboring countries for work. These shops can be improved in many aspects, including technological level, but there is no demand from customers and improvement efforts are difficult to be adopted because of foreign craftsmen. It is difficult to convert them to modern workshops, and their modernization is not likely to bring much benefits to the industry.

### 2.2.3 Needs for Technical Support Required by Existing Industry

Under the present conditions of the existing industry as described above, the large- and medium-scale light processing industry has the largest need for technical support. Their needs are not for research and development (R & D) such as development of new products,

but relate to 1) product improvement, including quality improvement, of presently produced products, 2) rationalization of production systems and productivity improvement for cost reduction, and 3) training of employees for upgrading of their capabilities. Many enterprises recognize the necessity of tackling these issues, but most of them have no concrete measures to take, due to lack of 1) information regarding the latest technologies and equipment, as well as modern production and quality management systems, 2) information on current market trends and current movements of similar industries abroad, and 3) expertise of expatriate managers having knowledge of latest production technologies, as well as 4) modern production and quality management systems.

More specifically, the technical support required by the existing industries is as follows:

- (1) Technical guidance and provision of technical information regarding the following aspects:
  - 1) Improvement and diversification of products, and improvement of quality
  - 2) Improvement of production lines, and rationalization of production system
  - 3) Improvement of productivity, and cost reduction
  - 4) Introduction of modern production and quality management systems
- (2) Provision of common service facilities or services to enterprises which help their quality and productivity improvement.
- (3) Training of employees for upgrading of their capabilities

Among the existing industries, the garment manufacturers commonly face most urgent needs for enhancing competitiveness by undertaking the above measures. The garment manufacturers in Oman, as mentioned earlier, concentrated on exports to US, and it is an urgent task before them to tackle the diversification of products and markets, and rationalization and upgrading of production systems.

In the case of the food processing and beverages industry, enterprises trying to export their products face the need to improve products, quality and productivity, require technical support to do that. Particularly the improvement of packaging is the most important task for them. As there exists no packaging material industry in Oman which can produce high quality packaging materials, package-using industries use either containers locally produced or make their own. The packaging containers used by them, except only a few of the large enterprises, are inferior in material quality, design and manner of packaging. Some manufacturers of processed food and other consumers' goods

are currently trying to develop export business, but most of them are required to improve their packaging that does not now satisfy to importers' requirements. Many enterprises engaged in production only for domestic market have no awareness of the value of packaging. As enterprises launching on an export campaign or manufacturing of new types of processed food increase, the need for improvement of packaging as well as improvement of products and quality will rise.

There are a large number of enterprises engaged in the non-metal mineral products industry and the metalworking and machinery industry, but most of those are engaged in small job-order work based on simple manual processing. Some enterprises require technical support for improvement of processing technologies and productivity, but in general there is little need for improvement of products as well as production systems. On the other hand, effect of such improvement will not be significant.

From the above situation, the existing industries which have relatively large needs for technical supports are the export garment industry and food processing industry, especially for their export business. Main items of technical support required by these industries are enumerated below.

(1) Technical support for the garment manufacturers requiring the diversification of products and enhancement of competitiveness

1) Technical guidance and provision of technical information regarding the following aspects:

- a) Modern technology for design and pattern making
- b) Improvement and rationalization of production lines
- c) Introduction of modern production and quality management systems applicable to garment industry

2) Provision of common service facilities or services to enterprises which help their quality and productivity improvement.

3) Training of employees for upgrading of their capabilities, particularly training on key personnel for the operation of production system based on the foregoing modern technologies and management systems

(2) Technical support for the manufacturers of processed food requiring the improvement of products, quality, productivity and packaging

1) Technical guidance and provision of technical information regarding the following aspects:

- a) Research for improvement of products
  - b) Improvement and rationalization of production lines
  - c) Introduction of modern production and quality management systems applicable to food industry
- 2) Pilot production tests and quality analysis related to research for improvement of products
  - 3) Quality test of packaging materials and shelf-life test of packaged food
  - 4) Training of employees for upgrading of their capabilities, particularly training key personnel for the operation of production system based on the foregoing modern technologies and management system.

## **2.3 Priority Industries for Technical Supports, and Nature and Type of Technical Supports Required**

### **2.3.1 Necessity of Selecting Priority Industries for Technical Supports**

As analyzed in the previous sections, the industrial accumulation as well as the scale of individual industrial undertakings are still small in Oman. Therefore, although there are a wide variety of specific needs for technical support, the beneficiaries of the technical supports provided for each need will be limited to only a few, because most of such needs are not common for many enterprises and hence limited to certain enterprises. For new industrial fields as well, as there are various investment opportunities, potential investors as well as existing enterprises will require various data and information needed for investigating feasibility of projects in a wide scope of industrial fields. Therefore, in order to meet a wide variety of these needs, the themes of research and information gathering must cover a wide range of technological fields and with depth. In actuality, however, it would be difficult to provide technical support covering all relevant fields of industry as well as technology due to financial constraint and limited human resource.

Further, if the technical support cover such a wide scope, it could not be efficient, since the beneficiaries of technical support would be limited in number. Accordingly, when the Center provides such technical support, it is realistic to start as the nucleus to be used for trials in preparation for future expansion, and thus it is necessary to select the priority industries for technical support.

### **2.3.2 Criteria for Selecting Priority Industries for Technical Supports**

The objective of the Center is to provide industries with technical assistance for promoting industrial development in line with the industrial development strategy and to foster the capacity of assimilating transferred technologies and accumulating technologies for further advancement. To meet this objective, the priority industries for technical support is selected by taking the strategic importance for industrial development and the needs for technical supports by industries as the criteria. As a result, priority is given to the following:

- 1) Industries requiring urgent improvement and having many beneficiaries.
- 2) Prospective industries to which priority is given for the promotion of development and for which the provision of technical guidance and information services are important.

Among the activities that should be given particular importance according to the industrial development strategy, the Center will particularly focus on the technology fields which will bring about direct contribution to the following factors:

- 1) Promoting economic diversification through the achievement of an optimum utilization of available natural resources on one hand, and the geographic location of Oman on the other.
- 2) Promoting the development of export industries in Oman.

Further, the following factors are also paid attention with a view to establishing the technological basis for the future, though these effects are indirect:

- 1) Adoption of advanced technology.
- 2) Further development of technology transferred from abroad.
- 3) Upgrading skills of the national work force to adapt advanced technology.
- 4) Assimilating modern technology.

### **2.3.3 Selection of Priority Industry for Technical Supports**

Based on the above-mentioned criteria, evaluation was made of the existing industries which have strong need for technical support and the prospective industries given priority for the promotion of development for which technical support is necessary.

#### **2.3.3.1 Industrial Fields Requiring Technical Supports from Strategic Viewpoint**

For promoting industrial development in the promising industrial fields, as described in Section 2.1., the need for strategically important technical support is as enumerated below.

- (1) Technical guidance and other technical assistance to be provided to existing industries for enhancing their sustainability for continuous growth.
- (2) Gathering and provision of information and assistance for product development which helps promote the export of industrial products.
- (3) Technical support for the development of new industrial projects, including the collection and dissemination of basic information for such projects. The basic strategy for industrial development lays emphasis on the promotion of industrialization with close linkage to industrial capital from foreign countries and based on overseas markets, focusing on the following areas:
  - 1) Promotion of export industries based on promising resources available in Oman, and also those having comparative advantages derived from geographic advantages and other favorable business conditions existing in Oman
  - 2) Promotion of industries which can serve foreign industries as their production base or distribution base for re-exports or regional distribution

To meet the above development strategy, the needs for technical supports are as follows:

- 1) The industrial fields requiring technical support for promoting and encouraging new investment by both domestic private capital and foreign capital for the development of resource-based export industries:
  - a) Development of large-scale gypsum mining for export.
  - b) Industries based on gypsum, kaolin and other non-metal minerals produced in Oman (such as gypsum board and plaster, ceramics and other building materials for domestic market and exports).
- 2) The industrial fields requiring technical support for development of supporting industries which are important for promoting the development of industries that can serve foreign industries as their production base or distribution base for re-exports based on geographic advantages of Oman:
  - a) Food industries for exports
  - b) Repackaging/re-export industries
  - c) Packaging industry related to the above industries

#### **2.3.3.2 Existing Industries Requiring Technical Supports**

Technical support required by the existing industries/ enterprises, as described in Section 2.2, are broadly as enumerated below.

- (1) Technical guidance and provision of technical information regarding the following aspects:



- 1) Improvement and diversification of products, and improvement of quality
- 2) Improvement of production lines, and rationalization of production system
- 3) Improvement of productivity, and cost reduction
- 4) Introduction of modern production and quality management systems
- (2) Provision of common service facilities or services to enterprises which help their quality and productivity improvement.
- (3) Training of employees for upgrading of their capabilities

Such needs will be imminent mostly for the industries undertaking exports, or those planning to undertake exports. Among the existing industries, the garment manufacturers commonly face the most urgent need for enhancing competitiveness by undertaking the above measures. In the case of the food processing and beverages industry, enterprises trying to export their products face the need for improvement of products, quality and productivity, and require technical support for such improvement. Particularly the improvement of packaging is the most important task for them. Many enterprises engaged in the food processing still have no awareness of the value of packaging. However, as enterprises launching on exports or manufacturing of new types of processed food increase, the need for improvement of packaging as well as improvement of products and quality will rise. There are a large number of enterprises engaged in the non-metal mineral products industry and the metalworking and machinery industry, but most of them are small and micro enterprises. Some enterprises require technical support for improvement of processing technologies and productivity, but in general there is little need for improvement of products as well as production systems. On the other hand, the effect of such improvement will not be significant. Under these conditions, the existing industries which have relatively strong need for technical support are the export garment industry and food processing industry, especially for export.

#### **2.3.4 Priority Industries (Technological Fields) for Technical Support - Satisfying Needs from Strategic Viewpoint and Needs from Existing Industries**

As the result of the evaluation, the following four fields were selected as the priority industries (technological fields) for the technical support. The rationale for this selection is enumerated below.

- 1) Upgrading and diversification of export garment manufacturing industry: The export garment industry in Oman primarily exports to the United States, where competition

with exports from other countries is becoming more and more serious. At present, as Oman still has some unfulfilled portion in its quota, orders are placed to the Omani garment manufacturers. However, as the export garment industry in Oman is essentially weak in cost competitiveness, the industry may become unable to sustain export competitiveness. The survival of the industry must be pursued through enhancement of cost competitiveness and diversification of products, improvement of quality, improvement of productivity by mechanization, upgrading and rationalization of production systems, as well as diversification of export markets. As mentioned earlier, the export garment industry is the largest non-oil export industry, and also employs a comparatively large number of Omani workers. Further, the industry has substantial impact on the service industry and other economic sectors. Thus, in order to sustain this industry, the technical support for the improvement and enhancement of the garment industry will bring about substantial effect to the economy.

- 2) Improvement of packaging particularly of food and beverages: Some food processing enterprises, which are users of packaging, face need for improvement of packaging for exports, and such need will increase along with the increase in enterprises engaged in export trade or undertaking re-packing business. To develop Oman so as to establish the function of a distribution center in the Middle-east region, as indicated in Vision 2020, is the important development strategy for effectively utilizing geographic advantage of Oman. Thus, the technical support for this industry have direct effect on the existing industry but also substantial effect from the viewpoint of development strategy. Further, in order to develop food processing industry as export industry, technical support is required for improving the food processing itself, including improvement of products and quality and rationalization of production lines, and also for assisting the development of new food processing business. There are some existing food makers requiring such assistance.
- 3) Promotion of development and use of gypsum and limestone resources: The economic effect from promotion of direct or indirect export of gypsum, which is available in great quantity in Oman, is expected to be significant. There are many potential investors interested in the development, but the information required for their making a decision is scarce, resulting in discouragement. A systematic approach entailing high costs is required for obtaining the required data and information. Therefore, the resource development will not progress on the basis of

individual investors' efforts alone. As the development of gypsum resource will greatly promote growth of non-oil exports and also the development of industry based on gypsum (e.g., gypsum board, plaster, etc.), the need for technical support is significant. Further, as there are similar needs for other mineral resources, the fields for technical support can be expanded in future.

- 4) Promotion of investment in the ceramic industry which makes most of the indigenous resources available. There are prospective markets for ceramic products in the neighboring countries of Oman, and therefore, there is a possibility that the advent of investment projects of ceramic manufacturing as long as such prospective ceramic raw materials as clay, kaolin and feldspar become available in this country. The confirmation of availability of ceramic raw materials alone, however, will not be sufficient for attracting the investment without research on the characteristics of the resources and suitability for use. Although there are potential investors having interest in the development of ceramic manufacturing, they cannot advance to investigation of project preparation due to lack of necessary information on raw materials. As the steps for promoting the development, it is important to provide such information to potential investors. For this end, comprehensive and continuous research on raw materials are essential.

### **2.3.5 Nature and Type of Technical Support for Priority Industries**

The nature and type of technical supports are different on each of the selected four industrial fields. These can be summarized as below.

#### **1) Technical supports for the export garment industry**

These comprise technical support for assisting in the diversification of products and enhancement of export competitiveness of the export garment manufacturers. The main activities for the technical support are as follows:

- a) Technical guidance and provision of technical information regarding the following aspects:
  - Improvement and diversification of products, and improvement of quality
  - Improvement of production lines, and rationalization of production system
  - Improvement of productivity, and cost reduction
  - Introduction of modern production and quality management systems
- b) Provision of common service facilities or services to enterprises which help their quality and productivity improvement.
- c) Training of employees for upgrading of their capabilities

These technical supports will establish modern garment production system in the industry, thereby building up the sustainability of the existing manufacturers and also establishing the base for further expansion in future. At the same time, the modern design and production/quality management systems introduced for the industry will be applied to other industries.

2) Technical support for improvement of packaging, particularly for the food and beverages industry

The main activities are as follows:

- a) Technical guidance and provision of technical information for the improvement of packaging
- b) Services for the testing of packaging materials, packing, shelf-life test of packaged food, etc.
- c) Enlightenment of the industry on the necessity for modern packaging, and diffusion of modern packaging technology

This support will enhance export competitiveness of the food and beverage industry, particularly food manufacturing enterprises undertaking exports, and also develop modern packaging industry in Oman which is important for developing the industries based on geographic advantage of Oman, such as repackaging and re-export industries.

3) Technical support for the development of gypsum mining

These are to promote the investment for the development of gypsum mining by carrying out basic research to acquire the data required by potential investors, particularly on property analysis and evaluation of suitability for use. These activities can be expanded for other resources in future.

4) Technical support for the promotion of development of ceramic industry

These are to promote the investment for the development of ceramic industry by carrying out basic research to acquire the data required by potential investors, particularly on property analysis and evaluation of suitability for use, as well as the defining of prospective deposits of kaolin, clay and other minerals for ceramic materials. In order to develop ceramic industry, it is important to carry out such research continuously.

## 2.4 Needs for Establishing the Center from the Priority Sub-sectors Selected

### 2.4.1 Needs of Export Garment Industry for Establishing the Center

#### 2.4.1.1 Current status of the export garment industry

The garment manufacturing enterprises in Oman are vulnerable, since their industrial base and technology accumulation are limited due to the short duration during which they accumulated industrial experience and to their dependence on expatriate managers and workers. Garment industry is necessarily labor-intensive industry. Thus, labor cost substantially affects the processing costs for garments, especially for low value items. As the garment factories in Oman are operated by expatriate managers and workers, garment processing costs are considerably higher as compared to the processing costs in neighboring countries where low cost labor is locally available. The Omani garment factories should also incur higher costs for materials, since all materials are met by imports, although these can be imported at international market prices under the free import duties and deregulated import procedures.

**Table2-1: Comparison of Competitiveness of Garment Industry**

	Unit	Oman	Malaysia	Indonesia	Viet Nam
Productivity	Sewing process	30 *1)	40	36	20
	Total process	18.4 *2)	23	24	13
Labor Cost	US\$/month-person	250	325	74	72
Working Time	hours/day	12 *3)	8	8	8

Notes: \*1) 20 pcs/day-person with 8 hours working-time/day.

\*2) 12 pcs/day-person with 8 hours working-time/day.

\*3) Including 2 hours of over-time work, which is the normal practice besides 10 hours of working-time/day.

The details follow.

In Oman, though the local demand for ready-made garments is small due to the small population and prevalent tendency of Omani people both male and female to prefer traditional wear, the garment manufacturing industry has emerged and made rapid growth of exports since 1989. It is currently one of the major non-oil export industries in the country.

At present there are 32 registered companies which are engaged in garment manufacturing for exports, which comprise 27 companies manufacturing ready-made garments from woven fabrics and 5 companies manufacturing knitwear.

Table 2-2 shows the current exports of garments in Oman.

**Table 2-2: Exports of Garments in Oman**

	<u>Quantity (1,000 dozens)</u>	<u>Value (US\$1million)</u>
1991	972.8	42.26
1992	1,868.6	83.13
1993	1,702.2	84.54
1994	2,201.0	114.17
1995*	1,152.3	57.87

(Note) \*A half year from January to June, 1995

(Source)MCI

The United States is the main export market, accounting for about 95% of the country's garment exports, while other export markets are Canada and the EC, accounting for the remaining 5%. The United States Government has adopted a quota on the import of Oman-origin garments since 1993, in view of substantial increases in US imports of Oman-made garments. The major buyers of garments made in Oman are those who intend to take advantage of the remaining quota, and the weak cost competitiveness of garment industry in Oman benefits from that quota.

The ready-made garment manufacturers in Oman produce a variety of outerwear using cotton fabrics as well as synthetic fiber fabrics imported from abroad. These are mostly low-value items being sold at supermarkets and discount-shops in the United States. All the Omani garment manufacturers undertake the production as subcontractors of foreign buyers by using fabrics and accessories such as buttons and zippers imported from India, Hong Kong, Taiwan and other Asian countries according to buyer's specifications and also based on design and patterns provided by the buyers. The knitwear manufacturers also undertake subcontracting for foreign buyers. They undertake only tailoring to produce low-value knitwear such as underwear and T-shirts by using knitted fabrics imported from Pakistan and other countries.

Most of the garment manufacturing companies employ expatriates from India and Pakistan as managers and supervisors for factory management as well as marketing, while also using expatriate workers from India, Pakistan, Sri Lanka and Bangladesh. Those factories are comparatively small in production scale, and typically operate 50 to 200 sewing machines.

Emergence of NAFTA is feared to seriously influence the future of the export garment industry in Oman, which exports mainly to the United States market, but lacks cost competitiveness.

#### **2.4.1.2 Strategic Focus for Developing the Export Garment Manufacturing Industry**

Emergence of NAFTA results in the same effect as expansion of a quota, giving preferential treatment to the products made in NAFTA countries. With NAFTA, therefore, Oman's advantage of having a quota will be minimized, and in order to take advantage of the quota, the manufacturers have to maintain competitiveness against Mexico or other suppliers in NAFTA as well as other countries.

Thus, the essential point for the development of export garment industry is firstly to increase its export competitiveness and survive in the export business, and then, improve the qualities of industry so as to become less dependent on others in designing, maintaining quality and raw material supply.

#### **2.4.1.3 Strategic Themes for the Center, and Its Needs from Industry**

To overcome the situation, the following strategic focuses are imperative:

- 1) To ensure the survival of the industry by developing it into an attractive supply source for buyers exporting products to the U.S.

Required actions:

- a) To decrease production costs through productivity improvement and mechanization; and
  - b) To develop the ability to meet detailed requirements from buyers by reducing time for pattern making and improving design skills.
- 2) In the future, to explore new markets with reducing high dependency on buyers for a single market, and shifting from low-end and mid-end products.

Required actions:

- a) Development of products lines appealing to new markets including Europe by means of original product development, modification of existing products, and quality improvement; and
- b) Sales promotion targeting buyers for the new markets.

Among them, sales promotion for export markets can be taken care of by the proposed export promotion center. Furthermore, support from trading companies established by OCCI can be expected to establish contact with buyers. Prior to sales promotion, however, cost reduction and the improvement of technological level are required on the industry's side. Since individual enterprises are unable to do them by themselves, technical support is essential and is expected to produce significant results.

In addition, the export garment industry is labor intensive in nature and is promising to create employment opportunities for local people. In reality, however, most of local workers working in the industry are engaged in odd jobs and are by no means indispensable labor force to support the industry. Concurrently with creation of employment opportunities, therefore, efforts should be made to train local people to have technical expertise and skills in design, equipment maintenance and other areas to replace foreign workers.

**Thus, following are the Direction of Technical Support to be provided by the Center.**

- 1) To provide the garment industry with technical assistance which can stimulate upgrading and diversification of product lines for generating higher value added as well as strengthening cost competitiveness of exports.
- 2) To create job opportunities for Omani engineers and/or technicians to undertake a part of production lines in the garment industry.

The contents of technical support, which require to achieve the purpose, are as follows.

- 1) Support for cost reduction by streamlining the existing production system
  - a) Technical support for introduction of production systems with advanced functions
  - b) Technical support for improvement of production control skills
- 2) Support for introducing and accumulating product development technologies
- 3) Support for introducing and accumulating skills for repairing sewing machines
- 4) Support for the quality certification necessary to undertake independent sales

Among them, the highest priority should be given to 1) that directly contributes to the survival of existing industries, followed by 2) and 3) that form the basis of future expansion and development. On the other hand, support in 4) focuses on the technology base which will be required when sales activity of original products emerges.

The following sections discuss the needs on the industry side for each type of support.



(1) Technical support for introduction of production systems with advanced functions

Mechanizing the operations - from development of samples to production of cut parts - that are now conducted manually, will enable costs to be reduced, quality to be improved, lead time to be shortened, etc. However, Oman's garment manufacturers are generally small in scale, and it would be difficult for them to individually carry out such mechanization. By installing the mechanized system as a pilot plant and allowing the companies in the industry to use it, the Center will contribute to reducing their costs; contribute to acquire the technology to utilize such system; improve their awareness of usefulness of the system and encourage them to acquire such system by themselves either individually or jointly, in the future.

Needs of Industry for the Center's Support

The needs for this kind of technical support are extremely high, and the anticipation that it would lead to autonomous product development, and market development, is also high.

In other words, given current conditions, the garment industry will have no choice but to continue its business with the current system of buyer-dependent development and sales, for the time being. However, should the industry fail to become competitive under this system, it will be unable to survive in international competition. Nevertheless, all the export garment manufacturing enterprises are dependent on factory management by expatriate managers and supervisors, who manage the production based on conventional production system and technologies which they gained through their work experience at garment factories in the home country. The garment factories in Oman carry out cloth preparation, cloth cutting and finishing mainly by manual operations. Hence the production results in high loss (waste) of cloth as well as unstable quality, causing high percentage of sub-standard products, and resulting in lowering production efficiency.

Therefore, they are obliged to introduce production systems having advanced functions, but the companies are too small to take such action. According to the manufacturers survey<sup>1</sup> conducted in the Study, all seven manufacturers responded by pointing out that they have been facing the challenge of improvement of their efficiency, and without exception expect prompt introduction of such system to a common service facility.

(2) Technical support for improvement of production control skills

The productivity of Oman's garment industry is quite low compared to that of the ASEAN countries. This is because production control is excessively concentrated on

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<sup>1</sup> The response of the manufacturers are shown in Table 2-3.

individual workers' goals and incentives, and because control policy is not built on management engineering techniques. With improvement of production control skills, besides the mechanization of production systems, cost would be reduced.

#### Needs of Industry for the Center's Support

In Oman there are no garment factories which adopt modern production management and quality management systems, since the production management and quality management are also dependent on the expatriate managers who follow their past experience. Hence when compared with garment factories in NIES and ASEAN countries, the factories in Oman use less advanced systems for production management and quality management, including material procurement planning, production planning, delivery planning and control, and total quality management. Thus it is hard to modernize the factories in Oman unless the management system is restructured. Some manufacturers have already noticed this situation, but none of them have taken action for improvement because of lack of knowledge, experience and support.

According to the manufacturers survey conducted in this study, two companies out of seven pointed out the need for improvement of production control methods, while five mentioned quality management and six are anticipating technical guidance for improvement.

### (3) Support for Introducing and Accumulating Product Development Technologies

To transfer product development technologies - for designing, pattern making etc. - to manufacturers and train their in-house personnel in these technologies.

#### Needs of Industry for the Center's Support

In the present business system, manufacturers are dependent on buyers, and their desire to improve their technology is not very strong. According to the manufacturers survey, only two manufacturers are aware that they have a problem of new product development and product diversification. Only one manufacturer is expecting the Center to do something for their human resources development, and another for design development.

This is because of the fact that an overwhelming majority of export garments produced in Oman, as mentioned earlier, is low-value items for lower class mass consumers, which mean small value added by production. The manufacturers in Oman have no original products developed by themselves, and undertake subcontract production on the basis of design and patterns provided by buyers to supply the products as per buyer's orders. Hence they merely undertake the production of low value products, depending on the orders placed by buyers.

The following are the factors attributable for their continued on subcontracting of low-value added products:

- 1) The level of the production system and sewing technology are too low to carry out sub-contract production of high-value added goods.
- 2) Since they have no designer, nor patternmaker, they do not have the capability to develop their own products, or improve their products.
- 3) They are not able to develop new markets, since they do not have their own sales network.

Thus, if they can acquire a prospect for improving cost competitiveness, they can then be expected to turn their attention to the next step: employee training.

In addition, it is indispensable that personnel training be approached not from the standpoint of individual companies but rather from that of elevating the entire industry. Moreover, at present vocational training schools teach sewing, but manufacturers have not set up OJT (on-the-job training) systems, so when students graduate they are still unable to put their knowledge to practical use. Product development skills, more than sewing skills, are believed to be easily accepted among the younger generation in Oman.

#### (4) Support for Introducing and Accumulating Skills for Repairing Sewing Machines

At present Omani companies rely on foreign workers for the skills needed to repair sewing machines; they are unable to cope on their own with the progress in equipment design. Training in repair skills that are suitable for the next generation of equipment to be introduced thereafter is necessary.

##### Needs of Industry for the Center's Support

Existing equipment consists of relatively old general-purpose machines that foreign workers are hired to repair. These foreign workers are replaced after short periods. It is desirable that systems in which the repairs are done by Omanis be established. However, such systems would most likely increase costs, so that manufacturers are not necessarily enthusiastic about them. Rather, this kind of service should be provided in view of creating job opportunities for Omani laborers.

#### (5) Support for the Quality Certification Necessary to Undertake Independent Sales

In the present business system, all production processes are conducted based on buyer approval: for example, buyers must approve the supply of raw materials, the supply of designs, and patterns. The checking of the final product is also done essentially by buyers. If, in the future, it should come about that manufacturers procure raw materials independently and sell products manufactured with non-approved designs, buyers will

demand that the manufacturers provide a reliable certification of product quality obtained from an impartial agency. The Center is to facilitate establishment of this function.

#### Needs of Industry for the Center's Support

At present, in one advanced case, such certification is in fact being demanded of a certain manufacturer, who has to obtain it from testing agencies overseas. Requesting such certification to overseas agencies costs time and money and is also inconvenient, especially when it has to be done frequently.

At present there is only one manufacturer that procures its materials independently. For the time being, test demand that could justify establishing such an agency cannot be expected. The action for this theme should be taken according to the future change of the business system.

#### Existing Plan and System for Improvement

There is no organization providing such function in Oman. It is the function for DGSM to provide tests. However, DGSM's tests are premised on regulations. The tests discussed here are requested independently by the manufacturer, and it is desirable that, based on the test results, technical guidance be provided to the manufacturer. Accordingly, it is desirable that the organization in charge of testing be the Center rather than DGSM. In that case, it would be possible for DGSM to retain the testing equipment and for the execution of tests to also be entrusted to DGSM via the center.

### **2.4.2 Needs of Packaging Related Industries for Establishing the Center**

#### **2.4.2.1 Packaging in Oman, focusing on packaging for food and beverage**

##### **(1) Overview**

Packaging in Oman mainly comprises consumer packaging for agricultural products, food and beverage, medical products, and paper products. No packaging is undertaken locally for protection of products from damage caused during the process of transportation.

The packaging industry in Oman includes manufacturers only of shopping bags and paper cartons. Other packaging materials are all imported, though the mineral water and beverage bottlers make PET and PVC bottles at their facilities.

Major packaging user industries in Oman can be classified into the following four types according to the degree of the need for addressing major issues related to packaging:

- a) Locally manufactured products which are mainly consumed within the country and partially exported: Products with consumer packaging are mainly food and beverages, paper products, and toiletry products including soap, perfume, cosmetics, and liquid

detergent. Most of these products manufactured in Oman are consumed in the domestic market, with some portions being exported. Products are not differentiated in design or specification for domestic and export markets, largely because the relatively small market does not justify production of diverse types of products. Manufacturing plants which use imported production equipment are generally equipped with packaging equipment, while packaging materials are mainly imported. Many packaging materials remain unchanged from the initial production stage, but some have been replaced with similar or equivalent materials. Since production has started in recent years, continued use of original packaging materials does not present a problem. Some manufacturers produce new packages bearing product information written in several languages for export, such as snack food. Transport packaging is seen for agricultural products, garments, furniture, and automotive parts such as batteries. Most of them use simplified or traditional cushioning materials to protect products from damage during transportation.

- b) Locally manufactured products which are mainly exported: Locally manufactured products for export, albeit small in volume and scope, include medical supplies and garments. Medical supplies are exported worldwide and are packaged according to international requirements. Garments are simply packaged for transportation as required by buyers.
- c) Imported products which are repackaged in Oman: Some of imported foodstuff are repackaged into smaller packages within Oman, such as edible oil, tea, coffee, and spice. They are consumed in the domestic market or re-exported. Packages for products consumed in the domestic market are generally inferior in terms of quality of packaging materials and designs including printing. Many products are placed in widely available plastic bags that bear no product information, with a label printed with a product name and the name of the distributor. Packaging materials for products to be re-exported (also sold in the local market) are mostly imported. Unlike industrialized countries, the significant role of packaging to play in adding value to the product, and creating an competitive edge in marketing, are not well realized in Oman.
- d) Imported products which are distributed in the domestic market with the original package: Most of imported consumable goods are in this category. Their packages are mostly as they are when imported. Since the distribution process of these products within the country is simple and short, their packaging is rarely damaged in the distribution process. From the standpoint of promotion of marketing, they should be repackaged after import or specially packaged by exporters to meet taste of local consumers. However, the small market does not provide incentive for doing so.

Some food products are sold with labels written in Arabic affixed to the original package.

## (2) Packaging in the food and beverage industry

Packaging used in the meat processing industry - those for frozen meat, meatball, and frankfurters - are made by using packaging equipment introduced at the initial stage of operation. They are maintained at a fairly high level of quality partly because of competition with imported products and partly because these products are also exported. Nevertheless, because of insufficient concern about packaging quality, there is a risk of packaging defects such as poor sealing and delamination that are not clearly visible from outside.

Packaging used in the dairy product industry is that which was introduced at the time of their start of operation. Since manufacturing plants are operated under technical assistance from foreign companies, packaging quality is also maintained at international levels.

In the vegetable and fruit industry, PAMAP processes and distributes products. Plastic bags and bottles are used for packaging, but much improvement seems to be required in selection of adequate packaging materials, and the improvement of packaging work and design. PAMAP operates 23 distribution centers throughout the country, which are responsible for collection, classification, segmentation, refrigeration and storage, packaging and shipment of agricultural products. Corrugated cardboard is used to pack small products, while cages are also used for bulk products.

In the seafood processing industry, frozen, steamed and dried products are packed in corrugated cardboard. Corrugated cardboard with wax coated inner face is sometimes used for transportation of frozen products.

In the edible oil industry, imported vegetable oil is refined and packaged in Oman. Plastic bottles used for packaging are imported.

Cereal processing is mostly limited to flour products at present.

There are many bakeries in the country, which pack products in plastic bags. Packaging quality does not present much problem because bread is not stored for a long period of time.

In the beverage industry, most packaging materials (with design) including glass bottles and paper packs are imported, except for a mineral water bottler that makes its own plastic bottles. Manufacturers using packaging equipment imported from Europe use packaging films which are preprinted. Their products are well packed.

In Oman, a relatively wide variety of chocolate products is manufactured. A large manufacturer (only one in the country) uses international-class packages including design.

On the other hand, packages by smaller companies are inferior in quality of packaging material and design, and have poor packing condition.

There are many companies repackaging a wide range of products including snack food, nuts, tea bags, coffee, salt, tomato, fruit powder, and spice. Those exporting their products maintain acceptable levels of quality in packaging material and design, while smaller manufacturers mainly serving the domestic market use transparent plastic bags with paper printed with product name and manufacturer (not necessarily indicated).

Generally, food is price sensitive and consumers tend to sacrifice quality for price. As a result, manufacturers tend to opt for price competition, rather than be concerned with quality. In Oman, however, the food industry operates relatively large plants imported from overseas, accompanied by relatively high levels of packaging quality. Yet the industry cannot procure packaging equipment and materials according to its own preference due to the relatively small production volume, and instead it has to choose from widely available equipment and materials. Typically, manufacturers, who have started commercial operation by use of technical assistance from foreign partners, terminate the relationship after the lapse of a certain period and continue operation by relying on foreign engineers. They tend to select less than adequate packaging materials over time. This creates a risk of packaging defects, such as insufficient sealing, not visible from outside, that would affect product quality, or delamination due to the use of inadequate packaging materials.

Food manufacturers in Oman seldom need to develop packing techniques and materials for their own products. Rather they select appropriate techniques and materials from the ones available in the market. The selection is not necessarily free due to the limiting factors including: 1) food's value being perceived by the market (market price), and 2) size of packaging materials used.

As Oman establishes its competitive position in the distribution system within the Middle East, manufacturers of frozen food and processed fish products, chocolate and candy, and soft drinks under OEM or licensing agreements with food companies in industrialized countries will grow in number, accompanying the increase in contract packaging. These companies are expected to have the ability to supply food products by using packaging materials and techniques acceptable in the international marketplace. Their parent companies or foreign partners are in position to provide food processing, quality control, and packaging techniques, together with package design. Packaging materials they need will be imported pre-designed, at the initial stage, but packaging development locally will increasingly become necessary in future to meet the local

conditions. The food industry will increasingly need to have the ability to obtain packaging materials with specifications and quality acceptable to the international market, to secure the maintenance system for increasingly sophisticated packaging equipment, and to obtain design and printing know-how as required.

(3) Other industries related to consumer packaging

Major industries related to consumer packaging in Oman, in addition to food and beverages, are medical supplies, paper products, and cosmetics, perfume and soap.

There is one medical supply manufacturer in Al Braimi, which serves the world market. It is one of the typical "processing and packaging" operations. Packaging materials including design are imported.

The paper product industry does their own packaging for tissue paper and paper diaper by using imported packaging materials.

Frankincense uses traditional packaging materials. High-grade perfume produced in Oman is packed in glass bottles designed and manufactured in Europe.

(4) Industries related to transportation packaging

Transport packaging to protect products during transportation does not play a significant role in Oman. Products for which transport packaging is important, such as electronic products, precision equipment, and heavy articles, are usually imported and distributed "as is" in Oman.

In Dubai, electrical and electronic equipment manufacturers are increasingly establishing regional headquarters or distribution centers, which will entail the need for transport package designs that take into account transportation conditions and availability of packaging materials peculiar to the region. They will increasingly need to have the capability of designing transport packaging to meet the transportation conditions and supply conditions of packaging materials, specific to the region. The same will be true for Oman if regional headquarters and distribution centers are attracted as planned. In such case, first of all, they have to have the ability to provide transport packaging sufficient to protect products which are increasingly sensitive and costly. Secondly, they must be capable of designing transport packages and procuring packaging materials locally to be ready for manufacturing new products in the Middle East. Thirdly, since most of the products and components manufactured at these facilities are exported, transport package must meet local conditions in export markets including distribution and environmental conditions. Finally, transport package and design must address environmental concerns in terms of appropriate disposal of packaging materials.



Fragile products such as china and porcelain require the transport packaging, but these products are not manufactured in Oman.

Transport packaging in Oman is generally done for food and beverages using corrugated cardboard and plastic cases. Apparel for export is placed in simple plastic bags which are kept in corrugated cardboard. This simple package is widely accepted without being subject to damage during transportation. However, future package design needs to satisfy environmental concerns in Europe and the United States markets.

**(5) Packaging materials industry**

The packaging materials industry in Oman produces plastic bags mainly for use as shopping bags. No plastic bottles for food packaging are manufactured. Mineral water and soft drink bottlers manufacture plastic bottles by themselves.

As for paper packaging materials, five companies produce corrugated cardboard and cartons, although all of them are converters.

There are many printing companies who have relatively high levels of printing techniques. However, package users generally ask European companies for design.

**(6) Physical distribution industry**

There are quite a few companies, including foreign subsidiaries, handling shipments from Muscat and Dubai. Although trading volume is fairly small, they are capable of handling international trade.

Nevertheless, none of them have the ability to provide service which helps streamlining customers' physical distribution systems.

**(7) Packaging machinery industry**

Packaging machinery is all imported with spare parts and accessories. Some manufacturers have used second-hand equipment from the start of commercial operation. There is no maintenance and repair facility in Oman.

**2.4.2.2 Strategic Focus for Improving Packaging Technology**

Most of the packaging user industries in Oman have started commercial operation fairly recently and are packaging their products by using original packaging equipment and according to original specifications. At the same time most of their products are destined to the domestic market, and therefore, their eagerness to improve packaging is low. The necessity to improve their packaging is not apparently significant. In this sense, a support system should be planned from a wider view point of promotion of packaging user

industries, rather than from the perspective of dealing with actual packaging problems alone.

Further, the demand for package and packaging technology will increase not only in the domestic market but also in the neighboring countries, accordingly with Oman's promotion of the function as physical distribution center in the Middle East. Strengthening of the system to meet such demand will increasingly become important for Oman. Nurturing the technological capacity in the field of transportation packaging will be essential in such case, with increased establishment of regional procurement centers and regional centers for physical distribution in Oman which will lead to increase in transportation of electric and electronics appliances, machine parts, and precision machines.

#### **2.4.2.3 Strategic Themes for the Center, and Its Needs from Industry**

To establish packing technology, the emergence of the packaging material industry is essential. However, domestic demand for packaging materials is fairly small and is satisfied by imports and in-house production by user industries for the time being. Accordingly, supportive efforts will be limited to the general objective of raising awareness of importance of packaging and the need for its improvement by providing technical guidance for packaging material users, while building up packaging know-how through efforts to solve packaging-related problems arising in the country. Although the scope is limited, this is the first step for establishing future packaging technology and will be able to meet demand from new entrants in addition to existing industries.

The improvement of packaging technology should include the improvement in design that is closely related to sales promotion, which will be addressed in the future when the need for improvement of industrial and commercial designs, e.g., the establishment of a design center. At present, such needs are dispersed throughout broad fields and must be fulfilled by overseas sources from the efficiency point of view.

#### **Direction of technical support:**

Given the above limitations, technical support for packaging technology should be directed toward the following areas.

- 1) To provide technical assistance for improvement of packaging in existing industry as well as new industrial establishments, particularly for those that are export-oriented, as the improvement of packaging technology is one of prerequisites for the development of export industries and the leveraging of the country's locational advantage as stated in Vision 2020.

- 2) At the initial stage, to focus the technical assistance on the packaging related to food industry, in order to provide the food industry (existing as well as new establishments) with a technical data base on advanced packaging technology, thereby to promote improvement of packaging, and also to provide technical assistance for improvement of packaging or application of suitable and economical packaging to meet quality requirements and characteristics of food to be packaged, particularly those for exports, in order to satisfy buyer's requirements as well as meet import inspection and standards in the export markets (countries).
- 3) In future to expand the fields of application of technical assistance to wider fields of consumers' packaging and also to industrial (transport) packaging.

The strategic focuses for the technical support in view of the above, are as follows:

- 1) Quality improvement of packaging materials made in Oman
- 2) Diversification of packaging materials
- 3) Improvement of techniques of food packaging work
- 4) Improvement of packaging design for food
- 5) Environmental preservation

(In addition, production and use of adequate packaging materials in the context of modern packaging technology, the improvement of packaging design and printing technologies, support for automation of packaging processes and maintenance, and package design for import products are other candidates, but all of them are too early to consider in Oman where the packaging material industry does not exist, together with the absence of major users of transport packages, the electrical/electronics industry and the precision equipment industry.)

Based on the above discussion, major elements of technical support to be provided by the center are summarized as follows.

Although existing enterprises do not necessarily recognize the importance of strategic focuses selected here, they are all indispensable from the viewpoint of development strategy. Considering that the packaging material industry is in its infant stage and industries using packages do not realize the need for improvement of package quality, it is recommended in the first step to implement strategic focuses in a flexible manner to meet the situation of individual enterprises. Thus, a basic activity plan should be designed to provide such flexibility and responsiveness to varying needs of individual enterprises.

It should be noted that the industry-wide activity alone is not likely to produce result so far as no company has packaging specialist.

The needs of industry will be analyzed in the following.

(1) Quality improvement of packaging materials made in Oman

The objective in this area is to improve production technology and quality control techniques related to packaging materials in order to prevent production of packaging materials having poor quality due to poor production practice and/or insufficient quality control. The first target will be the improvement of corrugated cardboard manufactured in Oman to eliminate irregularities corrugations or on the surface.

Needs of industry for the Center's support

Packaging materials produced in the country are mainly those of simple design and construction, including corrugated cardboard, cartons, PET bottles manufactured by mineral water and soft drink bottlers, and shopping bags. At present, deterioration of packaged products is not a consumer problem, and user industries are not active in improving product quality.

(2) Diversification of Packaging Materials

To provide support for new ventures or existing companies to enable them to use new packaging materials. This will become a major issue in immediate future for the food industry, with entry to the retort packed food and frozen food business, and use of heat resistant films for food heated at home.

Needs of industry for the Center's support

The present forms of packaging used by various manufacturers has been introduced only recently, and it takes some time until the need for new packaging materials will arise. Nevertheless, such information is important for companies who enter the food market. According to the manufacturers survey conducted in the Study, three out of four respondents are expecting the provision of technical and market information from the Center.

(3) Improvement of Techniques of Food Packaging Work

Typical examples of inadequate packaging due to inappropriate packaging work are seen particularly in sealing, fusing, and pinholes due to poor temperature control in the food sealing process.

Needs of industry for the Center's support

In the absence of complaints from the market and consumers, the industry has not well recognized the need for improvement of packages. According to the manufacturers survey, only two companies responded positively regarding the necessity of improvement of their packaging, out of the total of four companies.

Nevertheless, so far as the industry intends to enter the export market, inadequate packages need to be improved unless it is intended to target consumers satisfied with low-cost products. For Oman which does not offer cost competitiveness, it is very difficult, if not impossible, to enter the export market on the basis of cost competition. Rather it must rely on quality as a competitive edge. Awareness of need for improvement of package quality, therefore, will arise in due course.

The inadequate packaging is caused either through; 1) inadequate quality control in the food processing process, or 2) inadequate packaging work.

Given the lack of complaints on quality from consumers, food manufacturers are not likely to ask for technical guidance. Therefore, the Center should take initiatives such as:

- a) Offer general education through seminars and workshops
- b) Provide diagnosis and short-term technical guidance for selected companies who have interest in quality improvement.

Starting with these activities, the Center should take action aggressively for promoting improvement of packaging methods and technique.

IDD has previously drawn attention to the importance of packaging for the industry and JETRO has provided technical assistance including the sending of instructors. It was a short-term effort and continuous activity is required in future.

#### (4) Improvement of packaging design for food

The primary purpose of a package is to maintain the quality of its content. In this sense, packaging involves in every process of the food industry, including food processing, distribution, and storage. In particular, efforts should be made to help the industry achieve its purpose by providing technical guidance for existing manufacturers and supplying technical information for new projects.

##### Needs of industry for the Center's support

Selecting an appropriate type of package is an important issue for new products. On the other hand, existing manufacturers who already use certain types of packages do not feel the need for improvement of package design unless there is a strong demand from consumers.

Thus, the collection and provision of technical information will be given the first priority as the activity of the Center for the manufacturers who plan or adopt new products, or entities who start new businesses.

Besides that, effective assistance is needed for making product samples and its evaluation for manufacturers who plan to adopt new packaging. For this aim, the Center must have testing equipment for which the testing demand seems to be high, make it available to the manufacturers, or provide technical guidance before adopting new

packages. However, it seems to be very hard for the Center to satisfy all the demands for testing equipment in Oman, since the technology fields for which demand exists are extremely diverse.

#### (5) Environmental Preservation

The major themes include:

- a) Reduction of packaging materials that cause air pollution (e.g., chlorine-based packaging materials);
- b) Overall reduction of packaging materials consumed;
- c) Use of photolytic/biodegradable plastics; and
- d) Promotion of recycling and reuse of packaging materials.

##### Needs of industry for the Center's support

Environmental preservation efforts in Oman have still to be taken in a systematic manner and individual companies generally lack environmental concern. The need will arise as their exports face environmental control or regulation particularly on use of certain packaging materials in destination countries. Environmental preservation efforts are roughly divided into elements requiring committed involvement of related industries and government authorities, and those requiring adaptation measures of individual companies. Collection and analysis of information on export markets regarding their requirements regarding packaging in view of environment protection is the most important and urgent point to be tackled, while the support by public organizations in the form of testing, evaluation, and technical guidance is also important.

### **2.4.3 Needs of Ceramic Industry for Establishing of the Center**

#### **2.4.3.1 Current status of ceramics industry<sup>2</sup>**

The ceramics industries in Oman is fairly limited in scale and scope. Traditional ceramics manufacturers are divided into three types: 1) manufacturers of glazed earthenware that originates from unglazed water jars which have been made in Bahla and

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<sup>2</sup> Major products generally considered as products of the ceramics industry are cement and secondary concrete products, clay pipes, limestone and gypsum, refractory, red brick, glass, graphite, sanitary ware, tile, pottery and porcelain including earthenware and semi-porcelain. This section mainly covers the subsectors of the ceramics industry which use kaolin, an important resource that is expected to be available in Oman on a commercial scale. In addition, the section deals with pottery and earthenware manufacturing subsectors which is one of the ceramics subsector, but do not always use kaolin as a major material.

This section has shed light on the possible use of kaolin for papermaking. Despite the general belief that kaolin in Oman is unsuitable for such purpose because of coloration which has led to the use of kaolin exclusively for ceramics production, it is questionable if the use for paper manufacturing is entirely unfeasible.

its vicinities from early times, 2) the Ministry of Heritage's chinaware (earthenware) factory which uses machinery and craftsmen from China for the purpose of preserving and developing the traditional earthenware making technique, and 3) ceramic art crafts made by individuals who color and firing again the unglazed earthenware made by the government's chinaware factory.

In addition, a project to produce ceramic tiles is underway to meet increasing domestic demand, although it is by no means planned mainly for the purpose of using kaolin resources available in the country.

#### (1) Manufacture of Traditional Earthenware

In the area around Bahla, water jars made of unglazed earthenware have been made from early times. They are made from clay available in the area. Traditional earthenware includes incense burners used to burn frankincense as well as ornaments modeled on castles widely seen in Oman. Based on these traditional products, a few enterprises manufacture glazed products such as vases and pots. Some of them have electrical furnaces, while other shops and individuals still continue to produce unglazed earthenware. Most earthenware shops are operated as private concerns and their products are locally sold. Some areas are widely known as production centers to attract buyers who sell the products in Muscat and other areas.

Currently produced earthenware products are still using a traditional material, red brown clay with a seemingly high iron content. Also, it is fired at a low temperature of an estimated 1,000°C, resulting in products with insufficient strength. Glaze is purchased from foreign countries without checking affinity with local materials, as evidenced by cracking. Despite various efforts made so far by themselves, it would be difficult for these products to evolve from local earthenware craft.

#### (2) Ceramics factory of the Ministry of Culture and Heritage

To maintain and develop traditional production of earthenware, the Ministry of Culture and Heritage (MCH) has been operating a porcelain (earthenware) factory in the past 10 years by introducing machinery from China and inviting Chinese technicians. The factory mainly produces pots, vases and simple ornaments of varying size, both glazed and unglazed. It produces more glazed products.

The factory is equipped with a clay dissolving machine, a ball mill, a slip agitator, a slip pump, a filter press tug mill, power-operated potter's wheels of varying size, a tunnel kiln with a heat source burning diesel oil, and two down-draft, fixed hearth furnaces. Compared to traditional techniques, the factory has introduced the following techniques:

- 1) Cast-in molding method using plaster molds

- 2) Large pot molding using mechanical potter's wheels
- 3) Glaze production and application method
- 4) Design drawing method
- 5) Firing and firing control method

As for the clay for body, traditional clay materials available in Bahla and Al Hamra, as well as newly developed Muscat clay, are used either independently or in mixture. No other materials are mixed. Further, the Muscat clay is not much different from traditionally used clay, showing no significant improvement in quality. Generally, whiteness and hardness increase in the order of earthenware, chinaware (semi-porcelain) and porcelain, with decline in water absorption. Accordingly, they add more value as their use changes from decorative handicrafts to durable household utensils such as tableware. However, the lack of quality improvement prohibits evolution from earthenware handicrafts to higher value added products.

Low firing temperature, barely enough to produce unglazed earthenware, also contributes to products being relatively fragile and porous.

At present, products are sold at handicrafts centers operated by the MCH in Muscat and Nizwa and are purchased by government organizations (such as the Ministry of Public Works) as street furniture, e.g., flowerpots along the street.

The addition of kaolin to clay which will increase strength, trying an innovative design, and the establishment of sales channels, will lead to stable sales of products in increasing varieties, but these efforts are almost nil or insufficient at present.

### (3) Ceramic Tile Production Project

A project to manufacture ceramic tiles has been underway to meet increasing demand for ceramic tiles in the country and is now at the final stage of planning. It envisages 85% of primary materials to be locally procured.

As done by other industries, the project will use production technology that has been proved in other countries by purchasing production equipment. Foreign engineers will be hired to operate the plant. Thus, the planning process is to proceed without the project's own R&D resources and manpower, and material tests required to finalize production conditions are to be conducted by foreign equipment manufacturers.

It should be noted that information on ceramic material resources in Oman, including kaolin, clay, feldspar, and pottery stone, is still insufficient in terms of reserves and grade, creating a large risk for developers in relation to development cost and resource quality. The project is no except to this. The lack of companies' making their own R&D efforts generates serious concern about various aspects including high iron content. Apparently,



the project has selected production of tiles partly because they can be made by using relatively low grade materials; unlike other chinaware and sanitary ware, coloration on the tile body due to iron can be eliminated by the use of color glaze to make marketable products. This does not necessarily mean, however, that accurate information on available resources is not needed. Rather it will be essential in identifying and developing new applications for kaolin and other resources. MPM's information is useful for preliminary study, but it is still too generalized to be used for the project's decision making.

Once commercial operation starts, however, the plant will be capable of conducting necessary tests and R&D activities by using equipment to be procured as part of the project. Thus, so far as stable operation can be maintained, this equipment will serve the purpose until the need for product diversification and upgrading arises.

#### (4) Kaolin Resources

According to MPM's information, relatively high grade kaolin is available in Haushi and other districts. Kaolin constitutes one of the primary materials for ceramic products, together with clay, feldspar, and pottery stone, and major production centers of china and porcelain worldwide are all located in areas having rich reserves of kaolin. On the other hand, there is no project intended to exploit kaolin reserves in Oman.

Information on kaolin resources in the country is currently limited to the results of boring surveys, chemical analysis of sample cores, and mineralogical analysis. There is no research designed to use kaolin as a ceramic material, and which prevents the development of commercial application.

To determine usefulness of kaolin resources as a ceramic material, additional tests are required to determine viscosity, moldability, and coloration and shrinkage after firing at above 1,300°C. Moreover, body for high-grade ceramic products consists of at least 4-5 materials and, thus the blending test (for preparation of body) is required to judge the quality of raw materials. There is no testing organization able to conduct such a test in Oman.

As for the use of Kaolin for paper manufacturing, which is the major area of Kaolin consumption in the world, the Haushi kaolin is said to be unsuitable due to the lack of whiteness. However, suitability of kaolin for the paper-making purpose should be tested by using powder kaolin that has been washed. There is no testing organization able to conduct such a test in Oman.

Clearly, comprehensive research on use of kaolin resources is important from the viewpoint of utilizing natural resources to the maximum extent. In particular, a

comprehensive plan for commercial use of known kaolin resources, including low-grade kaolin (after excluding kaolin layers intermingled with oxidized iron, limestone, other stones that would adversely affect product quality), needs to be established taking into account the specifications requirements for each product segment, including tiles, sanitary ware, and porcelain.

Such research and planning activities cannot rely on private initiatives, and needs to be conducted by public organizations.

#### **2.4.3.2 Strategic Focus for Creating Ceramics Industry**

Based on the current situation of the ceramic industry, as discussed above, possible directions of promotion of ceramic production in the country will be as follows:

- 1) To focus on fostering of the traditional handicrafts earthenware industry from the standpoint of promoting small- and medium-sized enterprises and local industries.
- 2) To capitalize on available materials for ceramics production, e.g., kaolin, feldspar, and clay, and to promote industries specialized in production of ceramic tiles, china and porcelain, and sanitary ware according to actual resource availability and market conditions.

Promising products in the former case include souvenirs and ornaments, and tableware made on a wheel for the domestic market.

The promotion direction described in 2) above, would be materialized through introduction of modern ceramics manufacturing plants and technologies targeting export markets, including the Middle East, Africa, and Europe, besides domestic market. Promising products include ceramic tiles, tableware, and sanitary ware, which can amount to sizable demand in the domestic market alone, judged from import records. Nevertheless, potential demand cannot always be translated into actual business opportunity, and it is difficult to gain a large share in the tableware market where high-grade products are demanded and consumer taste diversifies.

#### **2.4.3.3 Strategic Themes for the Center, and Its Needs from Industry**

There are promising markets for ceramic products in Oman and neighboring countries, and the country has mineral resources required for ceramic production including clay and kaolin. These resources, if economically exploitable, would likely lead to viable projects. At present, availability of raw materials has only been confirmed, and no research and study is made on their commercial applicability. This is the main reason why commercialization does not progress in this field only.

To effectively drive commercialization efforts, the following information must be obtained:

- a) Technical and economic information on production equipment available from overseas resources; and
- b) Technical information on standards and specifications of products widely distributed in international markets as well as new products.

In addition to technical support, financial assistance will be required in some areas such as small-scale pottery production. Various organizations such as IDD under MCI are already providing various types of support in the investment stage.

At a later stage of commercialization, raw materials and products will be tested and evaluated upon request of manufacturers. In this connection, the scope of technical support needs to be extended with growth of the ceramics industry into: a) standardization, and b) technical consultation and advice on product and production.

Commercial exploitation of ceramic materials can only become feasible after research and study is conducted for their characteristics and commercial applicability, thus availability of resources alone never justify investment for their development. Other prerequisites are the provision of sufficient market information, proper guidance on production technology, and human resources development, which will surface at the start of a commercial project. In any case, the first hurdle to be cleared is commercial feasibility of raw materials which must be found in preliminary research, and technical support will emphasize the research area.

The following analyzes the needs for each themes.

#### (1) Research on Ceramic Raw Materials

The existing ceramic industry produces chinaware by using clay available in and around local communities. However, no study has been conducted to analyze properties of clay or to find alternative clay materials. Based on the two directions of development for the ceramics industry discussed earlier, the following activities are identified as strategic points of emphasis in the area of research on ceramic raw materials:

- a) Analysis and evaluation of clay available locally as ceramic raw material;
- b) Research on improvement of the currently available earthenware products
- c) Exploration of clay resources in other areas;
- d) Analysis and evaluation of local kaolin resources and research on utilization techniques; and

e) Exploration of other ceramic materials such as feldspar and pottery stone.

Needs of industry for the Center's support

At present, there are only a few earthenware manufacturers and some individuals who put colors on the earthenware produced by the factory of Ministry of Heritage, as the existing industry of this kind. However, given potential demand and relatively strong interest in new investment opportunities for manufacturing pottery and porcelain, found in the country, new projects aiming at fostering the ceramics industry can easily be promoted so far as commercially exploitable resources are found and detailed information is effectively communicated.

The Ministry of Culture and Heritage's factory uses various types of clay and glaze on an experimental basis, which is characterized as part of day-to-day production management, rather than research and development aiming at new product development. Clearly, more systematic research is called for.

The factory's facilities and equipment are mainly designed for production purposes, albeit relatively small in capacity. They are too large for testing and research purposes and do not include necessary measuring instruments. Laboratory equipment and devices should be acquired.

(2) Market Study

Anticipated themes under the market study include:

- a) To contribute product development ideas about chinaware products supplied by existing enterprises; and
- b) To conduct market research on ceramic products in Oman and neighboring countries, assuming the projects utilize a new kaolin resource.

Needs of industry for the Center's support

Like the ongoing ceramic tile project, a large enterprise may be able to conduct its own research when importing a new plant from a foreign country. In future, however, as more and more companies enter the market, not all of them will have the ability to conduct their own market research, particularly small project or enterprises. Accordingly, there will be an increasing need for market research to be conducted by an independent organization.

(3) Technical guidance on ceramics production

Study of properties of available ceramic raw materials and identification of products suitable for such materials are the presumed requirements for the establishment of the technical guidance services function. Further development of the industry which bases on the currently available raw materials is not prospective. The reinforcement of

products supplied by the traditional earthenware industry, would contribute to the extension of its market, to some extent, but this kind of research and developmental work should be carried out as part of activity related to research on ceramic materials, since the inferior strength of the earthenware is mainly because of nature of raw materials instead of production technology.

Needs of industry for the Center's support

At present, the need for upgrading the products of traditional earthenware industry is recognized, but potential demand for the technical guidance service will be insignificant.

The MCH-operated factory attempts to transfer modern technology to traditional earthenware producers by offering them jobs. They work at the factory for a few days per week and do their own work for other days. The technology transfer, however, is not based on a systematic testing and research on their raw materials and products.

(4) Human Resources Development

While modernized ceramic factories will be operated by expatriate engineers and managers at the initial stage of operation, it is desirable to replace them by Omani people step by step in future.

As for the small scale industry manufacturing china and porcelain, the entire range of production-related knowledge is required for their operation.

Needs of industry for the Center's support

It is not likely that the need for human resources development will arise on the industry side for a while, since the manpower requirement for the factory production of ceramic tiles will be fulfilled by expatriate labor. Further, the development of the existing earthenware industry will be limited so long as the product is in line with the current earthenware production. Such demand emerges only after promising products are successfully identified through raw materials research and market study mentioned above.

(5) Testing services

The following are the themes under testing services:

- a) Tests related to ceramic materials, including composition analysis and firing tests; and
- b) Product tests related to product strength, dimensional accuracy, and contents of lead and other harmful matter

Needs of industry for the Center's support

The ceramic tile manufacturing project currently under planning will have its own capability to conduct necessary tests on materials. Any product test, if required, should be intended for providing certification to a third party.

There is no need for testing in the family-operated sector.

## **2.4.4 Needs of Gypsum and Limestone-Based Industries for Establishing of the Center**

### **2.4.4.1 Current Status of Use of Gypsum and Lime**

#### **(1) Industries using gypsum and limestone**

The industries using gypsum and limestone in Oman are very small in size and scope as they primarily serve the domestic market.

While Oman has sizable gypsum resources, but their use is limited to cement production. Similarly, only small portions of limestone resources, although abundant in reserves, are used for cement, quicklime, and aggregates.

#### **(2) Gypsum resources**

Gypsum resources in Oman extend from the Shuwaymiyah deposit on the east coast to the Thumrait deposit, approximately 90 km west of Salalah. At present, two mines are operated in the Thumrait district to produce 48,000 tons annually<sup>3</sup>, which are mostly supplied to cement mills of two companies and partly exported to the UAE. For the Shuwaymiyah deposit, eight exploratory bore holes have been drilled and analysis of cores was completed in November 1993. The result has revealed very high grade gypsum deposits ranging from 90% and 98%, with the total reserve exceeding 100 million tons.

#### **(3) Possibility of use of gypsum**

One way to utilize gypsum resources in the country is to export it to other countries. The export market for gypsum is very large (e.g., Japan imports more than 3.5 million tons annually) and proximity of the known deposits to the Omani coast (1 km) makes exports feasible. According to a preliminary feasibility study on the gypsum export project undertaken for "Master Plan Study of Industrial Development", the project will be viable at the scale of annual production of 1 million tons, but not for 300,000 tons, though the study indicates that further study is required before implementing the project, particularly on 1) development of inland transportation and shipping facilities, 2) measures to ensure smooth loading under seasonal strong wind, and 3) economic study on removal of dolomite layers present between gypsum layers.

To further promote the project, it is important to provide information required by potential investors for decision making. In particular, detailed technical and economic evaluation on exploration and exports and collection of market information are required.

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<sup>3</sup> Source: MPM

Another promising way is to use gypsum as an industrial raw material. Major industrial products are gypsum board and gypsum fiberboard. In the GCC countries, Saudi Arabia has a gypsum board production facility that supplies small amounts to Oman via the UAE (as well as European products). However, building designs widely seen in the country and other GCC countries have very small demand for gypsum board.

Therefore, gypsum board production, if contemplated, should be considered as the project which intends to export its products to East Asia as well as Southeast Asia. In this connection, information on export markets and relevant technical information should be collected, and technical constraints on use of Oman gypsum for gypsum board production, if any, should be studied.

Significant demand growth is conceivable in Oman and other GCC countries if the use of gypsum board for buildings, hotels, hospitals, and apartment buildings is successfully promoted from the viewpoint of energy saving and fire resistance. If this becomes feasible, standards and specifications for gypsum-based construction materials in Oman and other GCC countries needs to be developed as an important part of efforts for active market development.

#### (4) Limestone resource

Limestone is one of the most abundant resources available in Oman and is widely distributed over the entire Oman mountains.

#### (5) Industry using limestone

**Cement production:** Cement production has been positioned as a strategic industry from a relatively early stage of economic development because cement uses limestone, a mineral resource abundantly available in the country and is an essential construction material to build physical infrastructure. Now two cement manufacturers are operating in the southern and northern parts of the country, namely Oman Cement Co. and Raysut Cement Co. Raysut Cement plans to boost its production capacity in 1996 from current 240,000 tons to 720,000 tons, and Oman Cement is considering a production increase. Oman has sufficient limestone reserves to support increased production. At present, cement production is kept at a level meeting domestic demand, and a short-term deficit is met by importing cement or its intermediate product, clinker, from the UAE. A surplus is mainly exported to the UAE or sold to internationally reputed cement traders. Raysut Cement exports its product to Yemen mostly on a regular basis.

**Quicklime production:** While a quicklime manufacturer and a slaked lime manufacturer are registered at MCI, they are actually the same company. Portions of quicklime produced by the company are used to make slaked lime for the domestic market. 65% of the remaining portions are exported to the UAE, and the balance used as a material for bricks produced by the company at a different plant. The company's quicklime production is still below its capacity, and the company is looking for an opportunity to increase production in future and has an interest in production of other lime-based chemical products.

**Other applications:** Other applications of lime in Oman are fairly limited, and comprise mainly consumption in the copper smelting process. Worldwide, limestone is used for steel-making, construction, and calcium carbonate production, in addition to cement and quicklime. For instance, Australia imports a large amount of lime for steel-making, in excess of one million tons annually. It is transported by large ships which are usually on return trip to Australia from exporting countries. For Oman to compete in the market, small port capacities are a major handicap. Other applications including aggregates for construction appear not to be highly feasible.

#### **Secondary use**

Most of ready-mixed concrete manufacturers are classified as "large enterprises" (seven establishments are registered). Geographically, about a half of them are located in populated areas of Muscat and Al Batinah, and others in inland areas of A'Dhahira and A'Dakhliya. In Dhofar, one manufacturer (unregistered) is operating and also produces mosaic tiles.

There are 15 manufacturers of tiles and mosaic tiles. Nine companies are classified as "large enterprises" and six as "medium-sized enterprises." There are five large tile manufacturers, all of which are located in Muscat. Four large mosaic tile manufacturers are located in Muscat or Dhofar. There are two medium-sized tile manufacturers, each located in Muscat and Dhofar. There are four medium-sized mosaic tile manufacturers, two of which are located in Muscat, one in Al Batinah and one in A'Dhahira. Tile production is economically located near the market and does not require large capacity.

Among primary materials for mosaic tile production, marble tip, powder, aggregate, and cement are locally procured, while white cement is imported. Large manufacturers use automated production equipment made in Italy, while small manufacturers still rely on manual work.



Detailed profiles of tile manufacturers are not known. They appear to produce cement-based tiles, not ceramic tiles.

Measured by the number of establishments, this subsector is dominated by small enterprises having capital of less than 25,000 Rials, which reportedly produce concrete blocks and other cement/concrete products by relying on manual labor. On the other hand, there seem to be many small crushed stone manufacturers.

There is one brick manufacturer in Muscat. It mixes sand having high silicon content and quicklime produced by its own plant near Quirt, added by water (with pigment as required) for chemical reaction. After molding, the mixture is heated by high pressure steam to produce silica-lime bricks. They are more expensive than concrete blocks and are mostly used for facing of buildings. There is no other manufacturer in the country.

#### **2.4.4.2 Strategic Focus for Development and Use of Gypsum Resources**

Among the non-metal mineral resources, gypsum and lime are one of most promising resources. Their commercial use would create direct or indirect export opportunities. There are many potential investors who are interested in development of these resources, but the lack of data and information required for making of investment decision prevents development projects from proceeding beyond the inception stage.

Exports of gypsum resources are not economically feasible with the current production volume and the existing loading facility, and large-scale development is inevitable. To attract investors for development projects involving investment in equipment import and mining, sufficient technical and economic information must be provided to allow them to make necessary decisions.

For promotion of the industries using gypsum and lime, a variety of information needs to be furnished to potential investors, including products and markets, manufacturing plants, and production technology required for production of new products, in addition to information on raw gypsum.

In this connection, it is recommended to conduct research and study on economic and technical feasibility of use as construction materials - major applications of gypsum and lime products - including social and economic impacts of new products (e.g., energy saving and fire protection effect). Following the preliminary evaluation of economic feasibility, commercial applicability for various products will be verified by manufacturers through experimental use.

Then, it is important to launch promotional activity for products which are considered to be economically feasible, which would help expand the market for the industry.

Finally, consultation service seems to be required for the existing manufacturers of gypsum and lime products to improve production technology, since many small enterprises operating in the secondary product area often supply mediocre quality products.

#### **2.4.4.3 Strategic Themes for the Center, and Its Needs from Industry**

An organization responsible for economic and technical feasibility study related to development of natural resources is MCI's Study & Planning Department. Based on the result of the department's study, center will evaluate and confirm technical feasibility in use of resources in question. In particular, the center will be responsible for the following activities:

- a) To conduct research on commercial use of resources which are prospective in terms of volume and provide the result. Also to provide information on products and markets, manufacturing plants, and production technology required for production of new products.
- b) To conduct research on economic and technical feasibility of use as construction materials - major applications of gypsum and lime products - including social and economic impacts of new products (e.g., energy saving and fire protection effect), followed by verification of commercial applicability for various products by manufacturers through experimental use.
- c) In addition, instruction on production technology will be given to manufacturers of secondary gypsum and lime products. For this purpose, sources and distribution of substandard products will be studied, followed by research on possible quality improvement measures that will form the basis of actual service. Data on substandard products will be furnished by DGSM, and research will be conducted under cooperation of SQU. Technical consultation and guidance will be provided for individual enterprises.

The following section discusses the needs of the industries for each of strategic focuses which have been identified.

#### **(1) Analysis and evaluation on availability of gypsum resources and their properties in view of its use**

To provide technical information related to availability of gypsum resources and their properties for potential investors who are interested in development of gypsum resources, export or utilization. Technical information includes the following:

- a) Structure and physical conditions of gypsum deposits, and estimated reserves
- b) Grade of gypsum and trace constituent

c) Physical properties of gypsum from the viewpoint of industrial use

This kind of information is formulated on the basis of those facilitated by MPM. The Center is to provide it to the industry adding own appraisal results from technological and economic viewpoints of use. However, more detailed information required for commercial exploitation of gypsum should be investigated by the project implementation body, while the Center will provide potential investor with only basic information.

Needs of industry for the Center's support

Even for large enterprises, exploration and verification of many potential deposits on the basis of limited information involves a very high risk. The lack of basic information partly explains why various mineral resources in Oman have not been commercially exploited despite the fact that many investors have strong interest. Thus, the needs for such activity is extremely high.

(2) Provision of technical information on gypsum/ limestone-based construction materials

The following technological information presumed.

- 1) To collect and supply technical and economic information on gypsum- or limestone-based construction materials: investment promotion by providing information for potential investors, and
- 2) Research and study on construction materials from the standpoint of energy saving and fire resistance, and promotional activity for commercial use of useful materials: with dissemination of economic impacts of gypsum-related construction materials that are not widely used in the Middle East including Oman, promote their commercial use and support market development.

Needs of industry for the Center's support

Though there is no business establishment in this industrial field, but according to the survey on manufacturers which produce similar products, or utilize such resource, there is strong interest among potential investors.

(3) Technical guidance on production of gypsum and limestone-based projects (mainly for production of construction materials)

Construction materials currently supplied by small- and medium-sized manufacturers include those accompanying safety problems. In particular, aggregates produced by crushing stones available in wadi often present a problem. This is because rocks and stones in wadi, while looking alike, often vary in physical property, but are generally used by the manufacturers without consideration to such difference.

The technical guidance is the major activity, while the research works on relationship between raw material rocks used and strength of construction materials, and forms the basis for the technical guidance.

Needs of industry for the Center's support

There are many manufacturers and suppliers of construction materials in Oman. On the other hand, the government enforces strict control on safety of construction materials, so that suppliers, particularly small- and medium-sized enterprises, have strong interest in technical guidance.

**Table 2-3 Response of Manufacturers to the Questionnaire for Technical Problems Facing and Technical Assistance Expecting**

Sector :	Non-metal Minerals Industry				Food Industry							Garment Industry							Others									
	1	2	3	4	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7			
<b>Company Profile:</b>																												
Major markets (in % of total)																												
Export to GCC	0	16	15	39	25	11	0	0	0	0	0	0	0	0	0	0	0	18	60	75	5	46	0	0	0			
Export to Non GCC	25	4	0	0	0	4	40	100	100	100	100	100	100	100	100	100	100	2	0	0	0	0	0	0	2			
<b>Technological tie-up with foreign companies ?</b>																												
Present																												
In the past	1																											
<b>Technical problems facing</b>																												
New product development	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Product diversification	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Improvement of production technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Improvement of production process	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Improvement of productivity	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Improvement of production control	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Improvement of quality control	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Packaging	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Others	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
<b>Technical assistance expecting from the IRC</b>																												
Testing	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Technical information	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Market information	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Standard development	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Human resource development	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Guidance for production technology	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Guidance for productivity improvement	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Guidance for quality management	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Guidance for design improvement	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Guidance for packaging	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Provision of common facilities	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Techno-economic study	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Own research and development	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
Others	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			

Note: "1" for "Yes".

