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ECONOMIC COMMISSION FOR WESTERN ASIA
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Joint ECWA/UNIDO Industry Division

Identification of Projects for Development of
Arab Regional Electric Motors Industry

- Some Suggestions -

Technical Advisory Mission
to
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Identification of Projects for Development of
Arab Regional Electric Motors Industry

- Some Suggestions -

1. Background: Demand for Electric Motors in the Arab countries has been rising rapidly with the establishment of industrial projects for manufacture of domestic appliances such as desert coolers, air conditioners, washing machines etc. and variety of engineering equipment. Recently decision has been taken by the Jordan Pension Fund (JPF) and Arab Industrial Investment Company (AIIC) to establish a factory in Jordan for manufacture of refrigeration compressors for use in domestic airconditioning units, refrigerators and deep freezers. This factory shall meet the unsatisfied demand locally, for compressors which have hitherto been imported. Annual capacity envisaged in the first stage will 500,000 numbers rising to one million compressors. This factory alone will require 500,000 motors annually in immediate future.

AIIC has conducted studies in development of electric motor industry in Arab countries - one of them through their consultants 'Sema Metra'. All these studies are in the nature of prefeasibility studies leading to identification of projects. Following alternative projects have been identified in these studies.

Alternative I : Two projects - first having an annual capacity of one million
(Sema Metra) motors to feed the proposed compressor manufacturing unit and the second one with an annual capacity of 2 million motors for fans of AC units, desert coolers and for washing machines.

Alternative II : One project with annual capacity of 4 million motors for all
(Sema Metra) applications.

Alternative III: One project having an annual capacity of two million motors
(AIIC) for all of above mentioned applications.

AIIC has further requested JPF to study the proposals in order to be interested in further promotion of the project/s.

These suggestions are made by Ashwani K. Narula, Regional Adviser, Industry Division ECWA in response to request by JPF. The following points were raised by JPF:

(a) Is there a good chance that electric motors manufacturing industry will be technically feasible and economically viable?

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(b) Are the alternatives suggested above are good or is there any other alternative through which viability of the industry has chance of improvement?

(c) Is it advisable for JPF to go ahead with detailed feasibility study as key organization to promote the industry?

It is not the intention at this stage to evaluate the studies already conducted on the subject.

2. Market for Electric Motors

2.1 Demand for electric motors in Arab countries^{1/}, as projected by Sema Metra is presented in the following table:

Demand for Electric Motors in Arab Region^{2/}

Category	Annual Demand in Numbers		
	Average 1976-1978	1985	1990
1. Industrial motors 1-100 HP	117,000	170,000	260,000
2. FHP squirrel cage (total)			
out of which	1,175,000	4,700,000	6,600,000
(a) Compressors		1,000,000	1,400,000
(b) Cooler and AC fans		1,000,000	1,400,000
(c) Washing M/C (Main)		700,000	1,000,000
(d) Washing M/C (Pump)		1,000,000	1,500,000
(e) Small pumps		500,000	500,000
(f) Ceiling and table fans		500,000	800,000
3. FHP - series round motors		450,000	2,600,000

Motors of higher HP have not been considered in the study as the demand for these is very low for consideration in manufacturing programmes.

As the manufacturing processes for three phase and single phase motors are, by and large, same in the case of squirrel cage motors no distinction is made in the demand. All fractional horse power squirrel cage motors shown in above table are single phase and all industrial motors are assumed 3 phase.

^{1/} SEMA METRA - Preliminary Study on the Manufacture of Fractional HP and Industrial Motors in the Arab Region - 1980.

^{2/} Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, UAE and YAR.

2.2 Major sources of supply of motors are West and East Europe and some Asian countries. Local manufacture is concentrated in Algeria, Iraq and Syria with very small factories in Egypt, Morocco and Tunisia. Taking note of the planned expansions of the electric motor industry projects, following local annual capacity position is likely to emerge in 1987-90.

Algeria

Industrial motors (15-500 HP)	4,500
General use standard (1/3 - 15 HP) motors	45,000
A/C and washing machine motors	57,000

Egypt

3/4 - 15 HP motors	25,000
thinking of expansion to	250,000

Iraq

Industrial (1-30 HP) motors	40,000
FHP (A/C units) motors	250,000
Pumps (desert coolers)	250,000

Syria

FHP (mainly washing machines)	100,000
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Morocco

1/3 - 75 HP	20,000
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Tunisia

2,000

In addition Libya has plan to establish a fairly good sized plant the capacity of which is not known - perhaps around 200,000 per year.

3. Constructional Differences in Various Types of Motors under Review

Before discussing the strategy for developing manufacturing capacity in the Arab Region, it will be prudent to discuss the constructional differences amongst motors for different application.

3.1 Motors for Domestic AC and Refrigeration Compressors: These motors are of high precision category. The compressors are usually built on unishaft basis and the motor/compressor unit is sealed in a single casing. If during operation any one of these two is damaged usually whole unit is replaced. Alternatively where maintenance labour is cheap the unit is taken back to the manufacturers service workshop - cut open - the damaged part (usually the motor) replaced and it is sealed again by careful welding. Later procedure is very

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expensive in most Arab countries and is thus not followed. It concludes therefore that motors for compressors have to be

- (a) specially designed for compressor;
- (b) extremely precision manufactured; and
- (c) having extended shaft.

Due to these reasons, large manufacture is of sealed compressors make their own motors. The small manufacturers, however, get these made other factories under their close supervision and strong inspection. These motors are usually capacitor start type.

3.2 Motors for Air Conditioning Fans, Washing Machine (Main) and Desert Cooler Fans: All these motors range from 1/4 to 3/4 HP and are semi enclosed, capacitor run, single phase type. These are made in standard frame sizes and there are no special requirements excepting that:

- A/C fan motors are multispeed;
- Desert cooler motor are generally single speed and,
- Washing machine motors, depending on design may be two speed.

Degree of precision in all these applications is not high.

3.3 Water pumps: For applications in desert coolers, machine tools etc. the pumps are made in single body encompassing the motor, and impeller. The construction is vertical and body is made of grey iron casting. Impeller may be of plastic, grey iron or brass. The motor is of shaded pole construction 1/15 to 1/8 HP. The product is marketed as whole pump.

3.4 Ceiling, Table and Pedestal Fans: The ceiling fan motor is an integral part of the body of the fan. Stator is in the centre while the rotor encircles the stator. The motor is capacitor run type. Regulation is effected by resistance or capacitor type regulators.

Table and pedestal fans embody the motors, pedestal and swivel motion mechanisms and are regulated in the same way as ceiling fans. The stator is outside while the rotor inside. Motors are shaded pole type.

The same manufacturer makes all parts of the equipment - motor, body, fan, regulator etc. with some bought out components like capacitors, resistors etc.

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3.5 Series Wound FHP Motors: These are used where speeds are high and have to vary in the appliance. Applications include domestic appliances - vacuum cleaners, blenders, coffee grinders, juicers, mincers, vegetable shredders and similar equipment. Here again, the motor is an integral part of the appliance, specially designed and made by the appliance manufacturer himself. As against the applications described at 3.1 to 3.4 above where the motors have squirrel cage cast into the stack of rotor stampings, the motor is wound with enamelled wire and has a commutator with carbon or copper brushes.

3.6 Industrial Motors vary in construction depending upon application but for most applications these range 1-100 HP. These are squirrel cage three phase shielded, semi enclosed or totally enclosed frame types. Further variations may be in RPM (revolutions per minute) duty cycle or whether these are floor or flange type. However, manufacturing technology is the same subject to limitations of the size of machine tools deployed for manufacture of the motors.

4. Production Lines - Preferred Combinations

From the above description following tentative conclusions can be drawn:

(a) Separate production line is required for - ceiling table and pedestal fans preferably separate factory/ies.

(b) Separate Plant/s for small household appliances which use series wound motors.

(c) Manufacture of A/C desert cooler fans and washing machine drum motors can be combined in one production line.

(d) Coolant water pump production will require another line.

(e) Should the economics of scale permit, the motors for compressors should be manufactured by the compressor manufacturer. If not, the second best choice should be that the motor and compressor factories should be under same management. Also in this case the compressor motors should be made in a separate production line. Both of these alternatives will avoid problems between seller and buyer. The third alternative is altogether a separate factory under a different company to manufacture all types of

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motors. This alternative should give the maximum advantage of scale but leaves the choice of source for bought out motor to the biggest customer i.e., the compressor manufacturer thus putting the motor factory into a great risky situation. The compressor manufacturer has to supply complete design of the motors and has to keep a very strong inspection team at the motor supplier's works.

(f) Small power industrial motors (say up to 3 motors) can be combined with general purpose standard FHP motors. However, there are various alternatives for economic manufacture but these are limited to availability and cost of intermediates. These shall be discussed separately.

5. Minimum Economic Plant Sizes Internal Integration and Suggested Approach:

The consultants for the preliminary study have suggested following minimum economic plant sizes for various categories of motors in terms of annual capacities.

Industrial	-	200,000	-	500,000
Fractional Horse Power Motors (squirrel cage)	-			1 to 2 million
Fractional Horse Power Motors (series wound)	-			2 million

5.2 The above figures appear to be high and are surprising. These are based on the sizes of factories in Europe (Western) which have grown over decades or perhaps a century. The reason for such minimum high figures given in the study is the competition from East Europe and China who may be offering their products at dumping prices in order to overcome their needs for foreign exchange and not by virtue of the facts of lower production cost and better managerial efficiency. This phenomenon is true for any industrial or even agricultural product. The Arab countries have to live with this fact and to decide for themselves whether to scumb to dumping practices and thus not to industrialise or develop their agriculture or to take measures to counter dumping practices from any quarter - East or West. Further, dumping practices are usually short lived to penetrate into new markets or to oust the existing suppliers. Once these objectives are achieved by the 'dumpers' they raise the prices to unprecedented levels.

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5.3 Secondly these plant sizes suggest that the developing countries specially the Arab countries who have decided to establish the motor manufacturing industry have done so without examination of technoeconomic viability. In short, their establishments will go bankrupt shortly.

5.4 Further thirdly the consultants themselves admit that the plant sizes suggested are based on 100% manufacture in factory including castings stampings and perhaps condensers (this condenser manufacture integration is not clear). The projects they have suggested are intended to cater to the entire demand/supply gap in the Arab region. It can also be concluded that the suggested regional projects with high scale economy can pricebeat the existing or planned units in individual countries.

5.5 Again it has been suggested and rightly so this time that the minimum economic plant size can be reduced by buying out castings and stampings. Also by deduction it can be concluded that all the existing plants in Arab countries are buying these intermediates. Perhaps they may be importing stampings as such or in the form of finished rotors and stators. They may be procuring castings from sister establishments or even importing them. Given the opportunity, the Arab motor manufacturing establishments would welcome assured supply of intermediates from Arab regional projects.

5.6 Since the objectives of any regional cooperation project is for development and growth of industry and to substitute imports and for sure not to have unhealthy competition with existing manufacturers, the first attempt should be to assure supply of high quality stampings through establishment of their manufacturing capacity.

Most countries presently engaged or envisaging to engage themselves in electric motor manufacture have also established foundries. In addition, Jordan the host country for compressors project is going ahead with a very modern flexible grey iron foundry. Should the need arise to further add facilities for non ferrous castings the foundries should not be hesitating to do so.

Manufacture of condensers and other small items is another matter and can be considered separately.

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5.7 Once the supply of intermediates specially the stampings is assured the problem is simplified. A large stamping plant will allow establishment of many industries for example:

- small domestic appliance manufacture
- ceiling, table and pedestal fan
- small transformers, voltage stabilizers - relay as well as servo motor types - even on small scale. etc. etc. etc.

To meet the supply demand gap for motors which will be tremendous even if a small fraction of demand for original equipment is satisfied through local manufacture, the following alternative should additionally be considered along with those identified by AIIC and SEMA METRA during further investigations.

6. The Recommended Additional Alternative

(a) To establish specialised manufacturing facilities for stampings to meet the demand for existing and future electrical motor manufacturing units - this will be a very dynamic industry growing with its end use industry;

(b) To allow the compressor manufacturing factory to build captive motor manufacture buying the stampings from the regional unit and castings from the proposed Jordan foundry;

(c) To keep a fair margin for expansion of existing motor manufacturing enterprises in Arab countries; as even then a very large gap between demand and supply will exist to justify Regional plants for motor manufacture;

(d) To establish standard motors manufacturing factory to fill the balance of the gap - a line for water pump manufacture can also be added.

When stampings and castings are available, manufacture of industrial motors can easily be expanded through existing and planned enterprises through a little coordination.

In conclusion, the projects for electric motor manufacture should be of keen interest to JPF - they present opportunity for attractive investment, and open the door for other industries. Their feasibility should be studied in detail to find out best alternative.

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