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Technological Development Trends in Iraq

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ABSTRACT

Technological aims and policies in Iraq have changed considerably since the fifties as they are linked with the policies of the social and economic development plan and in particular, the industrial sector.

Four main methods were used in technology transfer "Direct in general invitation", the "turn key" and subsequent "product-in-hand", "assisted direct implementation" and lastly "direct implementation". "The reversible engineering" method was also used in the Engineering Industry.

The manpower plan which is prepared by the Ministry of Planning takes into account the general requirement of the National Development Plan. The Industrial plan cover the cost of vocational training and other types of training as well as R&D activities.

Five examples of technology transfer experience were shown. The first two demonstrate the effect of technology's incompatibility with the new environment and the project planners' lack of proper information; the second two show the natural step-by-step technology transfer, and the fifth shows the direct result of direct implementation policy.

INTRODUCTION

Developing countries pay a fine as they climb the ladder of progress. The amount of this fine depends on many factors among which are the successful and extensive search in the international technology market, and the ability to select and adapt the technology which should fit in with the new environment.

Iraq is no exception to this rule. Until the early eighties, for example, there was no common understanding among the various branches and sectors of industry to the basic technology transfer terminology which led to considerable difficulties when negotiating technology transfer agreements. The Iraqi negotiator was unaware of many important points which should be taken into account when preparing and entering negotiation. Thus, it was an necessary to produce national guidelines covering this topic. These guidelines when completed covered various technology transfer terms, steps leading to successful negotiation and eventually better agreements.

Same indicators were used in Iraq to analyze and evaluate the technology level, but like all indicators they could be misleading and should be used with caution.

This paper deals with technological trends in Iraq. The subject is covered in three topics:

- Technology transfer policies and means in Iraq.
- The incorporation of training, R and D programmes in the National Development Plans.
- Selected examples of technology transfer experience.

I. Technology transfer policies and means in Iraq:

Iraq depends to a large extent on the outside world for purchasing machinery, equipment, and related know-how. Technology transfer agreements are usually conducted on an open international market bids and offers, except in a few cases when the information on the technology is considered a closely guarded secret for various reasons. The scope of technology transfer agreements includes such items as machines and equipment, know-how, electrical engineering designs, studies, erection or erection supervision, licensing, and technical assistance... etc.

The industrial policies in Iraq has changed considerably since the fifties. At the beginning with the exception of oil industry emphasis was put on consumer goods projects, such as food, soft and alcoholic drinks, leather products, textiles ... etc. All of which were owned and run by the private sector. Cement and refractory projects were fairly large projects compared with the branches of industry mentioned above.

The technology imported was simple and labour intensive. This can be well understood due to the unemployment situation at that time.

After the 14th of July revolution 1958, there was a considerable change in policies. The country was to be industrialized through a centralized planning system. Thus and in accordance with the Iraqi-Soviet techno-economic agreement signed in 1959, the projects implemented included agricultural implements, electrical fittings and transformers, medicine, textiles, and glass ... etc.

These projects were considered as fairly large and of high technology level. The Iraqi participation in choosing and evaluating the technology was very limited due to the fact that the Iraqi personnel had little or no experience in modern industry.

The bulkiness of these projects with their manual operations was a positive merit when one thinks about them today as the Iraqi work force at all levels had no experience in operating and managing modern industrial enterprises.

Then, Soviet experts were given the task of training the Iraqi Nationals when these projects were finally put into operation in late 1960s and early 1970s. Workers of agricultural background resulted in endless machinery breakdowns due to incorrect operating practices, thus improved maintenance systems were gradually worked out.

It can be seen without hesitation that these pioneer projects were like big vocational training centres which successfully graduated thousands of personnel, many of whom were given the task of implementing and then managing future projects with much higher technology contents.

In the 1970s a higher industrialization level was an objective in order to change the structure of the economy from one depending on oil revenue unilaterally to a diversified economy with special emphasis on the manufacturing industry and agri-industrial integration.

The following two methods were used in project implementation:

1. The Iraqi side through its local institutions announce the general specifications of the plant required, the supplier or the contractor is then asked to give his detailed offer on machines, erection, execution methods, process details and initial start up ... etc. The Iraqi side responsibilities are limited to supervision and some minor co-ordinate activities.

In this method Iraqi personnel must be able to distinguish and then evaluate the different technologies and associated machines and equipment, which was not always the case. It was found that this method worked fairly well on projects with technologies similar to those already established in the country.

2. Is a modification of the first method where the contractor is asked to do everything through what is called "Turn-Key projects". This method which was to dominate in the 1970s might have reduced the implementation time in many but not in all cases with added cost, smaller chances of technology transfer, and reinforced technological dependence.

Most of the big projects such as Iron and Steel, Aluminium semi-products, electrical wires and cables, cement, petrochemicals and many others, were implemented under this arrangement.

In the late seventies, there was a severe shortage of some constructional material such as cement and refractories. This led to the "product-in-hand" method of transfer which is an extended version of Turn-key projects, where the task of the foreign contractor is not only to design, supply, erect, start the project, but also operate and manage production at later stage. This method worked well when the contractor personnel were running the plant, but produced a complete stand still once these personnel left. It could be said without hesitation that the production-in-hand method represents one of the worst means of technology transfer.

In the eighties, the strategy was to concentrate on advanced technology intensive capital industry, and to go ahead with basic capital goods industry which eventually led to the 3rd and 4th methods.

3. The Iraqi institutions either alone or with the help of foreign experts individually or through consultancy agencies complete the project studies and designs. The foreign contractor task is limited to the supply of machines and equipment and execution under direct supervision of the Iraqi side. This method clearly gives the Iraqi personnel valuable theoretical and practical experience and better chances of technology transfer.

4. The direct implementation method is one important step ahead of the third method. The Iraqi institutions conduct all studies, designs, consequent project execution including erection, and initial start up. The responsibility of the foreign contractor(s) is to supply machines and equipment and erection in some cases. This method is highly encouraged and special generous incentive schemes are laid down with a wider scope of authority. The direct implementation aims are:

- Reduce implementation cost and time.
- Prepare the Iraqi staff to implement future projects efficiently.
- Reduce technological dependency.

A study conducted by the Ministry of Planning showed cost savings ranging from 5% to 65%, while there was no saving in time due to various organizational and management factors.

Technological dependency was reduced when the reconstruction campaigns started in 1991.

Another method of technology transfer which was used in the second half of the eighties utilized the principles of "Reverse Engineering". This method was applicable to the engineering industry where the product in question is disassembled, detailed design of assemblies, sub-assemblies and parts are then completed, relevant tools such as jigs and features... etc. are prepared and eventually used to establish production process.

This method aims mainly to acquire the technical know-how without actually paying royalties.

II. The Incorporation of Training, R and D Programmes in the National Development Plans:

The strategy in the national plan in the past two decades stressed among other things the following points:

- Illiteracy eradication, wide spreading of compulsory education, and free education at all stages.
- Improving technical training in order to face the demand created by the national development plan for the different skills.
- Paying special attention to R and D activities.
- Activating the role of universities and scientific institutes and their dynamic participation with the industry.

As a result of the above, the training centres have increased from (4) in 1968 to (28) in 1975. The number now is (20) - after merging some centres together. 28% of these centres belong to the industrial sector, 24% to the agricultural sector, while 21% belong to the Ministry of Labour and Social Affairs, the remaining percentage goes to other Ministries. These training centres cover over (103) trades and have trained over 53000 trainees during the period 1979-1983, for example.

Further to what has been mentioned above, there are about (200) technical schools run by the Ministry of Education, 20 higher technical institutes and (7) state universities run by the Ministry of Higher Education and Scientific Research.

The industrial sector (public & mixed) employs more than (200) persons with a Ph.D. degree, around (450) with a M.Sc., and about (20000) with a B.Sc. or technical diplomas as an average for years between 1980-1990.

By comparing 1990 figures with that of 1980, it can be seen that the number of employees without any education has dropped from around (100,000) in 1980 to around (51,000) in 1990, while the number of secondary school leavers have increased from (19,000) to (24,000) and those with technical diplomas from (4,700) to (9,420). This clearly shows that the general trend is towards higher qualifications. Production sectors are thus moving from labour intensive to capital intensive and hence the need for different work-force structures.

The estimate of human resources as required by the national development plans is usually carried out by the Ministry of Planning in the form of surveys. The national five year plan of 1986-1990, for example, showed that there was a need to train (53,000) trainees for the supervisory posts only.

The industrial plan which is part of the National Development Plan covers the cost of funding of the training centres in the industrial sector. It also bears the cost of training of personnel as soon as the project is approved. The cost of training is considered as part of the total investment cost of the project. There is no fixed ratio of training cost to project total cost. This clearly depends on the nature and level of the technology involved. Generally training abroad, local and site training, as well as foreign experts expenses who might be assigned to help the iraqi nationals at the early stages of commercial production after initial start up, are all part of training costs. In few cases, the plan even covers training cost for many years after the initial start up, that is, when it is in the commercial production phase, as in the central tool-shop project when the technology demanded such training.

As to R and D activities, the National Plan covered costs of such programmes until recently. Now industrial institutions bear such costs, while the national plan covers the cost of major projects which might include pilot plants, irrespective, in many cases, of the estimated cost or the results.

III. Selected Examples of Technology Transfer Experience in Iraq:

In the following few pages, few examples are given on the negative and positive sides of technology transfer experience in Iraq. The first two examples highlight the effect of technology's incompatibility with the local new environment, and the project planners' lack of proper basic information. While the third and fourth examples show the positive aspects of natural step by step technology transfer. The fifth example shows the direct results of one of technology transfer policies.

1. Spark plugs project

In the second half of 1970s, a spark plugs project was approved with an annual capacity of (3) million plugs: The investment cost was about (705,000) I.D (Iraqi Dinar) and the project was designed to produce (23) types of spark plugs. Production costs were estimated to be (301,500) I.D per year, while annual sales revenue was estimated to be (336,000) I.D, thus the project was to make an annual profit of (34,500) I.D.

The production technology was based on machining a hexagonal steel bar in a multi-spindle automatic lathe machines in order to get the approximate final shape of the metallic part of the plug. To achieve this 35% to 40% of the metal is wasted, reaching 50% at the final stages. Four of these machines were supplied to cover the required capacity.

The second important part of the plug is the ceramic insulator which was imported as a complete unit but with an inferior quality as specified by the technology. The rest of the process was slow and manual, while quality control was carried out visually, and final packing was in tens.

When the local market was fed with this home made spark plug, and was tried by car owners, many operational problems were faced. Some were so serious that the spark plug did not last more than few days in the car engine. Technical inspection revealed

severe damage to the insulator especially the powdered part and the electrodes. This was due to:

- Using the wrong plug for the particular type of car engine.
- Inferior quality insulators.
- Inadequate quality control inspections.

Finally production was forced to stop. In view of this situation a study was conducted which later revealed that the spark plug could not fit with the new environment. The Iraqi car owner was used for many years to purchase spark plugs by the thread length and not by the plug type suited best for his car, and due to the fact that 23 types of plugs were produced each one to fit a certain type of engine, one can readily understand what was wrong. Taking this into account together with the inferior quality insulator and poor quality control procedures, sales were reduced to almost zero as already mentioned.

The study also suggested that new technology was required which should take into account the following points:

- Utilizing as many as possible of the already erected machines and equipment.
- Lowering production costs and improving product quality.
- Taking into account the local environment and buying habits of car owners.

With an additional investment of (6,095,000) I.D, the production capacity was raised to (15) millions per year instead of the original (3) millions.

Production cost was estimated to be (2,183,000) I.D, while annual sales revenue was estimated to be (2,325,000) I.D. Thus making a profit of (142,000) I.D. and a positive hard currency saving of about (854,000) I.D.

Most of the additional investment went into improving both production methods and quality control inspection.

The metal wasting was reduced to 1% by cold forming, thus increasing daily production from (10,000) pieces per day to (66,000) pieces. Although the original manpower of 75 men was not reduced, but production was five times higher, and finally production was packed in fours instead of (10) plug pack.

Only (6) types of plugs were practically produced to cover most cars available in Iraq at that time.

2. Electric iron project:

This project was approved and implemented at about the same time as the spark plug project. Total production capacity was (150,000) units per year, while investment cost was (611,000) I.D.

Annual production cost was estimated to be (274,000) I.D. and annual sales revenue (350,000) I.D.

The iron outside design was not particularly attractive, relatively heavy, and heating element of (1000) watt.

The object of the project was to fulfil local demand on competitive bases, but when the product was shown in the shop windows alongside the different colour and shape of the imported irons with the added advantage of steam and nonsteam operation, and other technical and cost merits, the local iron had no chance of competing. The unlucky ones who purchased this iron had the unfortunate experience of clothes sticking to the iron, and difficulties in temperature regulation.

Production technology was manual in nature in six relatively small production sections.

Quality control was limited to insulation and thermal inspection only.

Due to the factors already explained, production was brought to a standstill. Many big firms were invited to study and submit their offer for factory improvement taking into consideration what existed already and market demand.

The best offer was chosen, and with an additional amount of (1,126,770) I.D., a new technology was suggested which has taken into account the followings:

- Introducing steam electric iron as well as ordinary with a modern design and a variety of colours.

- Higher automation by re-arranging machines layout in order to facilitate materials handling and production flow.

- Completely solving the problem of temperature regulation by individual factory "Setting Up".

- Reducing electrical consumption of iron (800 watt instead of 1000 watt), with non stick base.

- Introducing 100% quality control procedure.

With the new technology annual production cost was about (635,000) I.D., while sales revenue was (967,500) I.D. The new product was able to compete both in quality and price.

3. Transformer project:

Electric transformers were produced as one product of a fairly large variety of products in the electrical fittings and transformer project implemented in accordance with

the Iraqi-Soviet technical and economical agreement of 1959. Production annual capacity was 1200 of 11/0.4 KV transformer of different sizes ranging from 63 to 1000 K.V.A.

The investment cost of this project is not very clear due to the interchangability of machines and equipments, that is, the same machine was utilized to produce different parts for different products within the same production hall.

The technology was of the forties or early fifties vintage. Most operations were manual, material flow was intermixed with different products. The transformers were large and heavy, however, quality was acceptable.

The labour intensive technology can well be understood taking into account the unemployment factor, and poor industrialization experience at that time. The valuable experience gained in running and managing this plant by the Iraqi personnel enriched with the continuous search of the international market for the relevant technology, lead, when the Home and region demand was favourable around 1979 to implement one of the most modern plants in the region.

The annual production capacity was 6400 M.V.A. of which 3400 M.V.A. for distribution, and 3000 M.V.A. for power transformers. The sizes ranged from 100 to 1000 K.V.A. of 11/0.4 K.V., while power transformers ranging from 5 to 63 M.V.A., input voltage 132 K.V. for the 63 M.V.A. transformer and 33 K.V. for the others. Output voltage 33 and 11.5 K.V. for the big transformer and 11.5 K.V. for other transformers.

Total investment cost was	(25,754,000) I.D.,
Annual production cost was	(15,157,000) I.D.,
While sales revenue was	(20,700,000) I.D.

The project was executed by different foreign contractors, while site and management and supervision were carried out by the same personnel who operated the old plant and were later given the responsibility of running it.

The production of most mechanical parts (sheet, metal, ...etc.) was automated, computer aided design was introduced, material flow lines were streamed, and auto-inspection line to carry out various inspections was incorporated. All this led to manufacturing highly reliable and competitive transformers.

4. Radial tire project:

The same methodology for electric transformer project was repeated in the radial types project. In 1977, tire production plant was started with an annual capacity of (300000) tires of crossply type. With the accumulation of experience a new (3) millions tires per year project was implemented. Tires are of radial type to meet present requirements.

The difference between this project and the previous one, is that, execution was carried out by the Iraqi manpower and not by foreign contractors. It is now undergoing initial start-up inspections.

5. The re-construction campaigns:

As a result of the continuous heavy rocket and air attacks carried out by the allied forces in early 1991, which was directed to all aspect of life in the country, the industrial sector and in particular the National Electricity System was severely damaged. As an example, the following generating power stations were brought to a complete standstill.

Generating Station Type	No. of Units	Installed Capacity Damaged (M.W.)	% Age of Original Installed Capacity
Thermal	32	5215	96%
Gas	45	1476	85%
Hydro-Electrical	18	1894	84%

Making the total damaged capacity 8585 M.W., the extent of the damage differs, but reached 100% in some sites. The small undamaged capacity could not be operated due to severe damage to sub-stations and transmission lines and the absence of production requirements such as fuel and other materials.

Within few months electrical supply was fed gradually to the national network. No one anticipated such quick recovery due to the following two factors:

(a) The power stations and sub-stations was destroyed at random, that is, the damage did not take any particular pattern or shape.

(b) Severe shortage of material and equipment due to the comprehensive sanction.

The reconstruction of the electrical system was a big challenge to the Iraqi technical staff of all levels, because this activity was not an intensive maintenance work nor an execution and erecting a new project, nor expanding an already established one, and finally not re-starting an old plant. It was a mixture of all these in addition to the above two factors.

An organizational structure was established to cope with this task. New comprehensive procedures were followed, linked with modern planning and follow up techniques.

The following groups were formulated at each site:

- Technical group which was made of specialists in different disciplines such as civil and electrical engineering, automatic control, boilers and safety.

- Erection group which included men in such sections as mechanical, electrical, construction, instrumentation, material coordination, planning and follow up, and finally personnel and administration.

- Start up group which eventually was responsible for future operation.

A very generous incentive scheme was employed and the scope of authority was widely extended. Restrictions on work procedures both financially and administration were lifted. All this linked with the previous experience-gained through direct implementation policy laid down ten years earlier resulted in this speedy recovery.

The same principles were applied to the oil industry which was similarly damaged.

Lessons gained from the reconstruction campaigns are:

1. Future project implementation can be carried out by Iraqi manpower.
2. Erection period can be reduced when adequate managerial procedures are used.
3. Difficulties no matter how big they might be, can be overcome with determination, continuous search for alternatives, extended authority and generous incentives, all linked with previous knowledge and experience.

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