UNITED NATIONS
ECONOMIC AND SOCIAL COUNCIL

Distr.
LIMITED

E/ECWA/NR/SEM.3/6
13 April 1981

Original: ENGLISH

ECONOMIC COMMISSION FOR WESTERN ASIA

Seminar on Technology Policies in the
Arab States
Organized by ECWA with the Co-operation
of UNESCO
14-18 December 1981
Paris, France

TECHNOLOGY POLICIES IN THE CIVIL AND MILITARY SECTORS IN EGYPT

A COMPARATIVE STUDY

by

O.A. El-Kholy and N. Madkour*

* The opinions expressed in this document are those of the authors and do not necessarily reflect the views of the United Nations Economic Commission for Western Asia.

81-3913

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A Comparative Study

O.A. El-Kholy[1/] and Nazli Madkour[2/]

Introduction :-

The military contribution to the process of economic and social change in the third world countries is beginning to receive some attention. Three main schools of thought have emerged. The "modernizers", or output oriented, who see a positive correlation between defence spending and growth rates of GDP.[3/] The "welfarists", or resource-oriented, view the military as reactionary consumers of scarce resources.[4/] The third school, primarily represented by the German Federation of Scientists (VDW), or the "surplus-oriented", who see armament as contributing decisively to the process of capital accumulation and absorption of peripheral economies into the global capitalist system.

The study of the interactions between the military and civil sectors in the dynamics of socio-economic development is of particular importance in the Arab states in view of the exceptionally high expenditure on the former. Table (1) groups Arab states according to the percentage of their GDP allocated to military expenditure during the period 1970-75.

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3/ Typical of this school of thought is E. Benoit's Defence and Economic Growth in Developing Countries (1973) and Gavin Kennedy's The Military in the Third World (1974)

4/ An example is Ruth Sivard's World Military and Social Expenditures (1974) and the Disarmament and Development Report of the Group of Experts on the Economic and Social Consequences, United Nations publication ST/ECA/174, 1972.

Table 1. Military Expenditure in some Arab States[5/]

Military expenditure % of GDP	States	Number of states	
		Arab states	World wide
> 10	Egypt, Iraq, Jordan, Syria Democratic Yemen	5	7
5-10	Libya, Saudi Arabia, Somalia Sudan	4	11
2.5-4.9	Kuwait, Lebanon, Morocco, Yemen.	4	18
<2.5	Algeria, Mauritania, Tunisia	3	48

Ruth Sivard estimates that Saudi Arabia's military spending 1972 was 4.5 times that spent on education and health combined and that the ratio for Egypt was 2.2. The reasons for this are not far to seek. The Arab states have been at war with Israel for a third of a century. Hostilities have erupted four times during this period.

The case of Egypt is of particular importance and significance for such a study. Egypt is the most populous of the Arab states; its major socio-economic development effort inaugurated by the 1952 "Revolution" coincides almost exactly with the period of hostilities. It is comparatively one of the more developed countries in the Arab region and the termination of the state of war in 1979 marks the end of a stage in its historical development which calls for close examination. It may be relevant to recall here that for Egypt, as for most Third World countries, "expenditures on armament and expenditures for economic development are not seen as mutually exclusive policy alternatives, but as mutually complementary political

5/ The figures quoted for military expenditure here came from the publications of the Stockholm Peace Research Institute (SIPRI) and the US Arms Control and Disarmament Agency (ACDA).

necessities".[6/] One of the more profound and thorough studies of the role of the military in development dynamics in the Third World is Abdel-Malek's case study of Egypt. This explores in a very detailed manner the development strategy followed by the army officers since they seized power in 1952.[7/] However like other less thorough case studies, and perhaps by the nature of its terms of reference, it does not pay particular attention to science or technology policies, whether explicit or implicit. Science policy in contemporary Egypt has been analysed at some length in Zahlan's recent book Science and Science Policy in the Arab Homeland.[8/] While technology policies in the civil sector are beginning to engage the attention of economists and technologists alike,[9/] technology policies in the military sector have not-as far as we know yet engaged the attention of investigators even though a substantial portion of total technology imports is directly related to military activities. This is a remarkable omission, particularly in the case of Egypt where determined efforts to industrialize in the military sector started almost a decade before a civil ministry for industry was established and where a ministry of "military production" has been in existence for several years now. Many of the classical problems in technological development emerged first in the "military" factories. The history of these establishments is fascinating in itself,

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6/ Stephanie G. Neuman, "Arms Transfers and Economic Development, Some Research and Policy Issues", Arms Transfers in the Modern World, eds. Stephanie G. Neuman and Robert E. Harkavy, 1979, p. 229.

7/ Anouar Abdel-Malek, Egypt: Military Society, the Army Regime, the Left and Social Change under Nasser, New York: Random House, 1968.

8/ Antoine Zahlan, Al Ilm Wal Siassa Al Ilmia Fil Watan Al Araby (Science and Science Policy in the Arab Homeland), Beirut: Markaz Dirassat Al Wihda Al Arabia 1979 .

9/ Academy of Scientific Research and Technology, Science and Technology Policy Instruments, 1980. This is the country report (in two parts) of the International Development Research Centre (IDRC) STPI Project.

particularly when placed in the perspective of their genesis almost a century and a half earlier. It is hoped that this history might be the subject of some thorough research before it is obscured or lost altogether.

It is reasonable to assume that one of the reasons for neglecting technology policies in the military sector is the difficulty of obtaining detailed information on defence matters, particularly in Egypt, a developing country which was at war. The authors would like to make it clear that they have no particular access to such information, although one of them was for several years personally involved in the aerospace factories while the other has been conducting research on related matters.[10/] This report draws on the very scanty material published in Egypt or abroad, on the personal experiences of the writers and on a limit number of interviews. The authors have found a good deal of the information published abroad to be inaccurate in many details. They are particularly grateful to General Dr. Abdel Meguid El-Abd, the first Inspector of Vocational Training in the Armed Forces, General Khairy Kenawy, who occupied the same post until early 1980 and to Engineer Hassan Khallaf, Past Director General of the Department of Productivity and Vocational Training in the Ministry of Industry. Consequently, this report does not claim to be more than a very preliminary attempt at some very rough delineations of certain features of technology policies in the military sector in Egypt during the period 1948-75. Furthermore, it assumes some knowledge of the history of this sector and therefore will not attempt a narrative of this history.

In particular, this report focuses on a number of issues in the complex activities that has come to be known as the "building of indigenous capabilities", viz. manpower development; university/industry interaction; technological research and development activities, and the establishment of "industrializing" industry. For each of these, some of the more remarkable features of technology policies in the military

10/ Nazli Madkour, Egyptian Defence Programmes and their Impact on Social and Economic Development, M.A. thesis, American University Cairo, 1980.

sector in particular will be highlighted and contrasted with those in the civil sector.

The authors are fully aware of the fact that the sets of constraints and imperatives governing technological development in the civil and military sectors are quite different. They believe, however, that useful conclusions and orientations in the civil field could be learnt from the military field.

Manpower development :

Traditionally, the military everywhere have always been particularly sensitive to the role of training in their work. In the past, training has been mainly of a "tactical" nature. However, the decision to build a modern fighting force in Egypt in the fifties added a new dimension to training needs, that of "technical" training. This latter type of training assumed greater importance as more sophisticated weapon systems were introduced. Training at all levels within the military hierarchy was accorded a very high priority. Suffice it to mention here that "tactical" training started with the "top brass", who attended a very intensive course in modern warfare lasting for more than a year, under very arduous and stringent conditions outside Egypt, and before those under their command started their training.

We focus our attention here specifically on the mobilization of effort in the upgrading of technological capabilities of the Egyptian armed forces. The bulk of technological training was aimed at creating within the shortest possible period of time a strong and large enough force of skilled workers and technicians. There was very little in civilian life to draw upon:a problem the first intensive industrial development plan has also faced at the same time. The manner in which this problem was tackled in the military sector contrasts sharply with that in the civil sector.

Although a pilot project for vocational training was initiated by the International Labour Organisation (ILO) in

1954, two years before a ministry of industry was created, and although one of the three departments of the new ministry was that of "productivity and vocational training", most observers would probably agree that the problem of educating and training adequate numbers of skilled workers and technicians still awaits a satisfactory solution in Egypt.[11/] This does not, in any way, ignore or belittle the determined efforts of a few dedicated individuals in the civil sector; but it emphasizes the impression that the majority of the leaders in the newly-established industrial enterprises did not come to realize the crucial role of manpower development until a later stage in industrial development. The number of training centres established as well as their capacity remained well below existing needs. Furthermore there was no satisfactory method for training trainers. A survey carried out in 1966, ten years after the first industrialization plan, revealed that industry still needed 32,000 technicians, while the total number of graduates from vocational training centres over the same period reached no more than 11,399 by that date.[12/] The funds allocated to industrial vocational training were meagre, erratic and, with a few notable exeptions,[13/] not an integral part of the financing of new projects. The problem was also aggravated by the division of responsibility between three ministries and the variety of approaches and institutional organization in the source countries of the imported technologies in tackling the problem of manpower development, in general, and vocational training, in particular. The situation was further complicated by the prevailing value system which attached considerable social prestige to university education and white collar work.

11/ For example, the reports of the National Council for Education, Scientific Research and Technology, the Central Agency for Public Mobilization and Statistics.

12/ Central Agency for Public Mobilization and Statistics (CAPMAS), Vocational Training Centres in the UAR, June 1967.

13/ In particular, the Iron and Steel Complex in Helwan and the Kima Fertilizer Plant in Aswan.

Vocational training in the armed forces started in earnest in the mid-1950's when the post of "Inspector General for Vocational Training" was created. The manner in which the problem was tackled in the military sector of the time shows some remarkable features that merit close attention:-

1. Perhaps the most striking feature of all is that the language problem was faced squarely and resolutely. It was decided, right from the start, to produce all training material in Arabic. This involved a massive effort unprecedented in modern Egypt and reminiscent of the efforts of Mohammed Ali more than a century before. No less than 500 translators were engaged in this task and 1,000 books and training manuals were translated and used in the newly-established vocational training centres within a few years.[14/] A dictionary of technical terms compiled for the purpose by a distinguished group of technologists and linguists has become a classic and continues to be widely used today.

2. Particular emphasis was placed in arms sales contracts on training. These placed more emphasis on the acquisition of software and teaching aids, than on the hiring of experts. Brand new equipment earmarked for training purposes was included in hardware procurement contracts. For each foreign expert, three to four national counterpart staff were appointed to ensure maximum absorption of transferred technology; as a quick method for on-the-job training of trainers; and as a guarantee against turnover in national staff.

3. A special salary scale for trainers and trainees (mainly volunteers) was introduced. Consequently, recruitment problems were considerably reduced and a degree of stability and continuity in the system achieved, reflecting the enhanced status of technical staff in the military hierarchy. Distinguished skilled workers could join the "Military Technical Institute" and move into the officer corps upon graduation.

14/ Compare this with the so-called "Project of a Thousand Books" initiated by the Department of Culture in the Ministry of Higher Education and which has published about 700 books since it was started in the 1950s.

4. Considerable effort was directed towards adaptation and upgrading of training methods and material. Fairly effective procedures for assessment and innovation were established and these led eventually to the initiation of research work in a number of aspects of the training process under local conditions.

5. Technical training in the military field was very sophisticated. In fact, the specializations for which training courses were available in the military sector in the 1960's (around 125) were more than three times those provided in the much more heterogenous civil sector (around 30-40). No estimates are available of the relative cost of skilled worker training in the civil or miliary sectors. For the latter, one unconfirmed estimate indicates that four to five per cent of the funds allocated to procurement of hardware went into technical training. In another estimate, the cost of technical military training is believed to have been about LE 150 a year per trainee in the late 1950s and early 1960s. This figure seems to have reached about LE 600 a year per trainee in 1979. It is further claimed that per capita expenditure on vocational training in the military sector was some two to three times higher than the expenditure in the civil sector.

Military experience with higher level technological manpower was less fortunate. Plans were drafted in the late 1950s, with the help of expertise from the Military Technical College in Brno, Czechoslovakia, to establish a military " technical college" (MTC). The idea was to split the stream of entrants into the officer corps into two subsidiary streams: the traditional, "tactical" stream and a new "technical" stream. "Technical" officers were to graduate from the new MTC after a three-year course. Yet, the Egyptian commandor

in this venture pressed very hard and were persistent to turn the MTC into a "super" school of engineering at the university level. The course of study was extended to five and a half years, considerable emphasis placed upon "academic" subjects and plans for establishing "science" departments were considered. The graduates were meant to be an elite corps of engineers, of a higher standard than the normal run of engineers graduating from Egyptian universities at the time. The college was almost entirely staffed by foreign experts and the running expenditure per student was estimated to be no less than 20-30 times that in the civil schools of engineering in the universities.15/

It is possible to appreciate the aim of training first-rate engineers for the army and the feeling, prevalent at time, that education at the "tertiary" level in civilian life was suffering from lack of resources coupled with unhealthy expansion. Yet, failure to fill the crucial gap at the middle level between the skilled worker and the university graduate had disastrous effects. Ten years after the original plans for MTC were prepared, a military "technical institute" had to be established on almost identical lines to those of the plans for MTC as envisaged a decade earlier.

The same trend of pushing " technical" institutes graduating senior technicians to become university colleges turning out graduate engineers can be seen in the civil field. It is mainly the result of the prevailing value system and the considerable prestige of the university degree - factors that certainly do not exist in the military field and that render this aberration less justifiable in what is essentially an " open" system where upgrading from one level of technical manpower to the next is recognized practice.

15/ As estimated by El Kholy in 1964.

University/Industry Interaction:

Mention should be made here of a rather unique example of university/industry interaction in the Egyptian aerospace industry.[16] Two remarkable policy decisions were taken at the outset which could be related to two past unsuccessful experiences in developing a national capability in the aeronautical field. It was decided:

First: that all design and development work was to be carried out on Egyptian soil;

Secondly: that every foreign expert should have at least one Egyptian understudy.

This led to bringing in the concerned department[17] in the universities right from the start. University/industry interface was established at all levels in a rather unique fashion:-

1. The head of the university department was appointed a member of the Supreme Council for Aircraft and Aero-engine Industry, the highest authority in this set-up.

2. The senior academic staff in the department were retained as consultants at the factories, shuttling daily between the two, supervising the induction of young engineers - mostly ex-students of theirs - in the mixed design and development team and advising the Egyptian management.

3. The students were sponsored by industy. They were paid a monthly stipend, trained abroad at its expense and guaranteed employment after graduation.

16/ El Kholy: A Case Study of University/Industry Interaction in Modern Technology Transfer, presented to the "Workshop on Transfer of Technology between Scientific Organizations and Industry" during the "Science/Industry/Technology Interactions" meeting held at the University of Alexandria Research Centre (UNARC), Alexandria, Egypt, 14-17 April 1980.

17/ At that time the Department of Aeronautical Engineering in Cairo University was nearly ten years old. It was the only department of its kind in the whole of the Arab Region and the African continent and had always had several Arab and African students.

The impact of this unique relationship on the university was remarkable:-

1. A small department was soon acting as a department of advanced technology, spearheading daring innovation in curricula and teaching practices to be followed by other departments in the university.

2. The staff had a very sharply-defined profile of the type of graduate needed by the aerospace industry and could tailor their curricula and courses to the requirements of the future employer.

3. The feedback from the design office, the shop-floor or the test rig to the class-room was almost instantaneous. Very often, the teacher/consultants were discussing with their students experiences of only a few hours old.

4. The majority of research students came from industry with real life problems for which they were seeking detailed analysis, rather than the " ad hoc" solutions they have already devised in industry. Graduate studies and technological research flourished further because of the physical facilities made available by the factories.

Although imposing the academics was not generally welcomed by the "old guard" in industry, the academics came to play a number of useful roles particularly in a set up where a highly-disciplined expatriate team under the command of a resident chief viewed the added burden of inducting their Egyptian counterparts with feelings ranging from acquiescent reluctance to open hostility.[18/] The academics acted as interfaces at a number of crucial junctures: between management and the young engineers for whose technical competence and personal behaviour the academics were assumed to bear a "moral" responsibility; between the expatriate and national staff on technical

18/ It is worth mentioning here that, within two years of the start of one of the projects, the chief aerodynamicist was a young Egyptian in his twenties.

matters; between the manufacturer and the user; and finally between the factories and the Superme Council.

The authors do not know of any similar examples of close industry/ university relations in the civil field. They could however, cite cases where the university or industry turned down offers for co-operation for a variety of reasons that merit close examination.[19/] They believe that the sharper awareness in the military sector of the incipient dangers of heavy reliance on foreign sources of technology is the main force drawing national elements closer together in military technological development. This seems to have been strong enough to overcome security considerations and the typical aloofness and reserve of the military. It is almost incredible that after several decades of intensive industrialization, no departments of industrial engineering have been established in Egyptian universities, nor have production technology, industrial management or product design and development received particular attention, at a time when departments for "nuclear engineering"; "computers and automatic control" and even "biomedical engineering" were established.

19/ The most striking example that comes to mind is the refusal of the Department of Metallurgy in Cairo University to assume a supervisory role over the newly-established institute within the iron and steel complex in Helwan in the late 1960s. This attitude changed somewhat of few years later.

Technological Research and Development:

Like most developing countries, Egypt has its fair share of applied research institutions [20] established in the hope that they would contribute significantly to technological competence and innovation in the development "battle". True to form, these have, on the whole, had little impact on the course of events.[21] The problem of effective linkage of the scientific, the technological and the production activities is still with us.[22] Not many examples come to mind of the widespread use of products manufactured according to local designs or to major adaptions of imported technologies. The few notable examples of indigenous creativity had to leave it to the industrialised countries to exploit these innovations.[23] All this is common knowledge now and need not occupy our attention here, since specific cases and aspects will also be discussed in some detail in the work of the seminar.

However, one particular feature in the civil sector is worth alluding to here. In 1968, ten years after intensive industrialisation effort, an "Engineering and Industrial Design Development Centre" was set up in Egypt with considerable financial and technical support from U.N. organisations. It was directed towards the promotion of industrial development in the country as well as the design capabilities in different engineering fields. This could be taken to reflect an awareness of the need for building up an indigenous technological capability that would reduce the extent of the country's dependence on imported technology and its products, and to develop the ability to unpackage technology imports and increase local shares in such packages. It took ten years of industrial development effort before this need could be identified. Yet this proved to be a forbidding task, in spite of the valiant efforts of the Egyptian leadership and the sustained support of U.N. organisations. Few state-owned

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20. e.g. those for metallurgy, petroleum, electronics, construction to name but a few.

21. A.B. Zahlan, Ibid.

22. O.A.El-Kholy: The structure and Functioning of Technolgy Systems in Developing Countries, UNIDO Document, ID/WG.301/2, June, 1979.

23. e.g. the BMA Egyptian Sugar Process

industrial enterprises, by necessity medium or large in size, showed an interest in drawing on the services of the centre rather than on their original sources of technological "know-how" and hardware abroad. Small scale industry worked mostly at a very low-level of technological sophistication producing cheap crude products in a seller's market - an environment that militated against technological upgrading as a means of competing for a larger share of the market. The iniquities of the strategy of import substitution, as applied to local production in Egypt of the wrong products (consumer goods for the higher economic stratas) and the resulting entrenchment of the position of the foreign suppliers of technology, and particularly the TNC's, have been investigated by economists.[24/] Although the impact of these strategies on the strengthening of indigenous technological capabilities has yet to be analysed in detail through specific case studies, it is fairly clear that it has - on the whole - militated against fulfilment of the aims of the "Engineering and Industrial Design Development Centre".

In rather sharp contrast to this situation, one can trace in the military sector a persistent emphasis on building-up design and development capabilities. The list of successive attempts at developing hardware for specific needs is long and impressive. The end products sought varied considerably in complexity and military significance. They ranged from small radio-controlled target planes for training purposes to supersonic interceptors, from rifles to fairly large calibre guns, from small rockets to heavy missiles of medium range. In some cases the effort was totally national with no foreign involvement, while in others there was considerable involvement of foreign expertise. In almost all cases where success in producing acceptable prototypes was achieved, the designs did not go into serial production - the exception being perhaps some small arms

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24/ O.A.El-Kholy (ed): Assessment of industrialisation Policies in the Arab Region, IDCAS Document in three parts presented to the Fourth Arab Industrial Development Conference, Baghdad, December 1976 (Part I : Economic Assessment , by A.Mohieddine).

and a twin-jet subsonic trainer. It is clear that the unsophistocated industrial infra-structure and the embryonic state of heavy and basic industries, could not support this. Imported inputs constituted a large portion of the end products. Yet, the authorities continued to provide substantial funds for such efforts.

The defeat of 1967, spurred efforts to adapt and modify some of the more sophisticated weapons in the light of that experience. A special "technical"task force was formed within the staff structure of the high command to monitor adaptive and development effort. Quite drastic and daring modifications of several products were attempted with considerable success. Such efforts met with open resistance, mainly from the foreign suppliers who objected to what they considered as "irresponsible tampering" with their products; but who later adopted some of these modifications in the new models. It must also be stated here that some of the "top brass" in the technical wings of the military hierarchy , were quite sceptical about the practical value of these efforts in changing the military balance in the field of battle.

Perhaps the most striking example of a totally national technological development effort that had a decisive impact in the battlefield, is the high pressure water jets used to cut through the gigantic sand embankments built all along the Eastern bank of the Suez Canal to prevent a massive crossing into Sinai. Although current opinion before the outbreak of hostilities and the crossing of the Canal in October 1973 was that this was an almost impossible feat [25/] that would entail unacceptable losses in human life. Work went on for many months and in almost total secrecy to develop the water jet system, procure the bits and pieces of hardware from a variety of sources, test the system and place it in position. It has

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25/ e.g. "The Military Balance of Power in the Middle East. An American View", Journal of Palestine Studies, Vol 1,No.3, Spring 1972, Beirut, particularly p.7 where a 'US Aide' states that "the Egyptians have enough amphibious weapons to cross the Canal, but they would not be successful if they attempted a crossing". It has also been said that some Soviet military experts felt that only a nuclear device could breach these dykes.

been said that the concept was inspired by the fluidisation technique used to pump colossal amounts of sand from the west bank of the Nile to build the earthen body of the Aswan High Dam. Other notable examples of sustained development effort-going through the phases of review of the state of the art, some basic and applied research, engineering specification, production and prototype development - included Laser gunsights, a novel torpedo guidance system, a "Sonar". A small jet engine of unorthodox design was " copied" and produced in sizable batches and used to power a subsonic jet trainer, while a new design of a relatively powerful by-pass jet engine was completed and a prototype used to propel an Indian designed jet fighter at supersonic speed for the first time.[26/] This was mainly the work of foreign experts and could at best be considered as a chance for national personnel to be introduced to the intricacies of such ambitious projects. By way of contrast a "pocket" submarine was designed, built and tested through a predominantly national effort.

It is both interesting and significant to note that at the same time that such activities were going on, the "military" factories administered by military staff were producing - as sideline products for civilian use - hand-operated meat mincers, sewing machines, gas-fired "geysers", household refrigerators and telephone sets under licence, rather than according to locally-developed designs. It is clear that the same climate prevailed here as in the civil industrial sector.[27/] There were no special considerations pressing for the development of indigenous designs.

There remains one other feature of technology policies in the military field which the authors consider of particular significance and is worth a passing remark.

26/ SIPRI, The Arms Trade with the Third World. Stockholm: Almqvist and Wiksell, 1971, p.285.

27/ A notable exception is the project for producing Diesel engines of modest powers around a basic single cylinder design which was developed from scratch with assistance from an Austrian designer. The engine is still being produced in a variety of numbers of cylinders to drive irrigation pumps, electric generators, etc.

This is the early realisation of the importance of developing engineering industries, as a necessary basis for sound military production. Until this very day, the best ferrous and non-ferrous foundry in the country is within the military factories administration. It is nearly thirty years old, has gone into a number of re-equipment and modernisation projects and is currently producing intricate cylinder blocks for the water-cooled petrol engines of small passenger cars and the finned air-cooled cylinders of Diesel engines used in trucks. The first aluminium wire drawing unit, the only machine tool manufacturing plant, and even the early beginnings of the large iron and steel complex in Helwan, were all within the military factories administration and not in the civil industrial sector. This is regarded by the authors as yet another clear example of the concern in the military sector with the building of indigenous technological capabilities in a vital industrial sector.

Concluding Remarks

The authors realise that this report has done no more than introduce their subject - a subject which they believe merits detailed analysis based on thorough research. The question now arises as to the "moral" of this story that would justify their concern and interest in this particular page in the history book of technological development in modern Egypt.

The authors certainly have no intention of singing the praises of "militarisation" of development effort, nor do they mean to denigrate what has been achieved in the civil sector. In drawing attention to certain features of technology policies in the military sector, they were not even contemplating contributing to the ongoing debate on the role of the military in socio-economic development in the third world countries. Furthermore, as has been stated in the introductory remarks, they are fully aware of the very different environments of formulating technology policies consciously or subconsciously - in the two sectors. They would like to emphasise particularly their awareness of the fact that the period under review was one in which Egypt was at war. It

is a historical fact that the military factories in Egypt were established immediately after the first round of the Arab - Israeli War in 1948. For thirty years military needs have had a lear priority and first claim on available resources. The military administrations are perhaps less constrained or " squeamish" about spending relatively large sums of money. They are also by their very nature considerably more "disciplined" and effective than civilian administrations. The lines of command are more sharply defined. Effective monitoring and control of implementation in the field is basic in military thinking.

All this is perfectly true and significant in explaining the discrepancies between the two sectors in the same country at the same time. Yet it does not in itself explain the differences in orientation and policy. The explanation lies perhaps in three basic features of military life:

1. the particularly sharp awareness of the decisive role indigenous capabilities and self reliance play in war situations, where foreign supplies are insecure, even before the outbreak of hostilities.

2. the clear understanding and practice of a " system" approach in military thinking and action. This leads to a broader view of problems and an early realisation of the ramifications of decisions in a particular area and the quick establishment of forward and backward linkages.

3. the great importance attached to manpower development and training which continues throughout a military career. This, together with the "system" approach and the considerable variety in endowment and qualification of military manpower resources, have prompted the practice of detailed work analysis and job specification. Training needs are based on such thorough breakdowns of work involved.

Perhaps the only real justification for this report is that it draws attention - at a time when some are beginning to lose heart and despair of implementing the often-repeated resounding slogans current in the third world countries - to the fact that we have had in our midst, within our own Arab societies, and in recent times, clear examples of the realisation of at least some of the basic elements of technological self-reliance. Considering the technological sophistication of military technology, it should be quite feasible here and now to repeat, let alone emulate, our own recent experiences- this time in civilian life and with the full confidence that they can succeed. Perhaps we have failed to draw the attention of decision-makers to these achievements so that they may pursue the same technological policies in the civil sector. Hence the need for more detailed study of technological problems in the military sectors.
